HITACHI

PA | No. 0093

20CX20B501
20CX20B511
20CX20B521

SERVICE MANUAL

NTSC | NA6L CHASSIS

R/C: HL00761

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SPECIFICATIONS AND PARTS ARE SUBJECT TO CHANGE FOR IMPROVEMENT

SOLID STATE COLOR TELEVISION

MAY 1997 **HHEA-MANUFACTURING DIVISION**

SAFETY PRECAUTIONS

NOTICE: Comply with all cautions and safety-related notes located on or inside the cabinet and on the chassis or picture tube.

WARNING: Since the chassis of this receiver is connected to one side of the AC power supply during operation, whenever the receiver is plugged in, service should not be attempted by anyone unfamiliar with the precautions necessary when working on this type of receiver.

The following precautions should be observed:

1. Do not install, remove, or handle the picture tube in any manner unless shatterproof goggles are worn. People not so equipped should be kept away from the picture tube while handling.

2. When service is required, an isolation transformer should be inserted between power line and the receiver before any service is performed on a "HOT" chassis receiver.

3. When replacing a chassis in the receiver, all the protective devices must be put back in place, such as barriers, nonmetallic knobs, adjustment and compartment covershields, isolation resistors, capacitors, etc.

4. When service is required, observe the original lead dress in the high voltage circuitry area.

5. Always use the manufacturer's replacement components. Critical components as indicated on the circuit diagram should not be replaced by another manufacturer's. Furthermore, where a short circuit has occurred, replace those components that indicate evidence of overheating.

6. Before returning a serviced receiver to the customer, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock, and be sure that no protective device built into the receiver by the manufacturer has become defective, or inadvertently defeated during servicing.

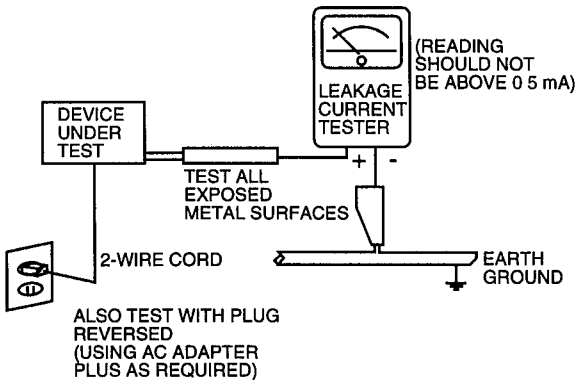
Therefore, the following checks should be performed for the continued protection of the customer and service technician.

Leakage Current Cold Check

With the AC plug removed from the 120V AC 60Hz source, place a jumper across the two plug prongs. Turn the AC power switch ON using an insulation tester (DC500V), connect one lead to the jumpered AC plug and touch the other lead to each exposed metal part (antennas, screwheads, metal overlays, control shafts, etc.), particularly any exposed metal part having a return path to the chassis should have a minimum resistor reading of 0.24Mq and a maximum resistor reading of 12Mq. Any resistance value below or above this range indicates an abnormality which requires corrective action. An exposed metal part having a return path to the chassis will indicate an open circuit.

Leakage Current Hot Check

Plug the AC line cord directly into a 120V AC 60Hz outlet (do not use an isolated transformer for this check). Turn the AC power ON. Using a Leakage Current Tester (Simpson's Model 229 or equivalent), measure for current from all exposed metal parts of the cabinet (antennas, screwheads, overlays, control shafts, etc.) particularly any exposed metal part having a return path to the chassis or to a known earth ground (water pipe, conduit, etc.). Any current measured must not exceed 0.5 milliamps.


(READING SHOULD NOT BE ABOVE 0 5 mA)
LEAKAGE CURRENT TESTER
DEVICE UNDER TEST
+
-
TEST ALL EXPOSED METAL SURFACES
2-WIRE CORD
EARTH GROUND
ALSO TEST WITH PLUG REVERSED (USING AC ADAPTER PLUS AS REQUIRED)

AC LEAKAGE TEST

ANY MEASUREMENTS NOT WITHIN THE LIMITS OUTLINED ABOVE ARE INDICATIVE OF A POTENTIAL SHOCK HAZARD AND MUST BE CORRECTED BEFORE RETURNING THE RECEIVER TO THE CUSTOMER.

High Voltage

This receiver is provided with a hold down circuit for clearly indicating that voltage has increased in excess of a predetermined value. Comply will all notes described in this service manual regarding this hold down circuit when servicing, so that this hold down circuit is operated correctly.

Serviceman Warning

With minimum BRIGHTNESS, PICTURE, SHARPNESS, and COLOR, the operating high voltage in this receiver is lower than 27.7kV +/-1.25kV. In case any component having influence on the high voltage is replaced, confirm that high voltage with minimum BRIGHTNESS, PICTURE, SHARPNESS, and COLOR is lower than 27.7kV +/-1.25kV. To measure high voltage use a High Impedance High Voltage meter. Connect (-) to chassis earth and (+) to the CRT Anode button. (See the following connection diagram.)

Note: Turn power switch OFF without fail before the connection to the Anode button is made.

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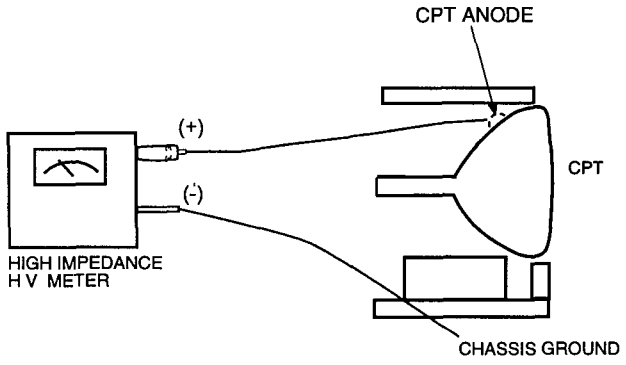
PRODUCT SAFETY NOTICE

Many electrical and mechanical parts in HITACHI television receivers have special safety-related characteristics. These are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts which have these special safety characteristics are identified in this Service Manual.

Electrical components having such features are identified with an ⚠ mark in the schematics and parts list in this Service Manual.

The use of a substitute replacement component which does not have the same safety characteristics as the HITACHI-recommended replacement component, shown in the parts list in this Service Manual, may create shock, fire, X-radiation, or other hazards.

Production safety is continuously under review and new instructions are issued from time to time. For the latest information, always consult the current HITACHI Service Manual. A subscription to, or additional copies of HITACHI Service Manuals may be obtained at a nominal charge from HITACHI Sales Corporation.



X-Radiation

TUBE: The primary source of X-Radiation in this receiver is the picture tube. The tube utilized in this chassis is specially constructed to limit X-Radiation emissions. For continued X-Radiation protection, the replacement tube must be the same type as the original HITACHI-approved type.

When troubleshooting and making test measurements in a receiver with an excessive high voltage problem, avoid being unnecessarily close to the picture tube and the high voltage component.

Do not operate the chassis longer than is necessary to locate the cause of excessive voltage.

This Service Manual is intended for qualified service technicians; it is not meant for the casual do-it-yourselfer. Qualified technicians have the necessary test equipment and tools, and have been trained to properly and safely repair complex products such as those covered by this manual. Improperly performed repairs can adversely affect the safety and reliability of the product and may void warranty. Consumers should not risk trying to do the necessary repairs and should refer to a qualified service technician.

WARNING
Lead in solder used in this product is listed by the California Health and Welfare agency as a known reproductive toxicant which may cause birth defects or other reproductive harm (California Health and Safety Code, Section 25249.5).

When servicing or handling circuit boards and other components which contain lead in solder, avoid unprotected skin contact with solder. Also, when soldering do not inhale any smoke or fumes produced.

SAFETY NOTICE
USE ISOLATION TRANSFORMER WHEN SERVICING

Components having special safety characteristics identified by ⚠ on the parts list in this service manual and its supplements and bulletins. Before servicing this product, it is important that the service technician read and follow the "Safety Precautions" and the "Product Safety Notices" in this Service Manual.

For continued X-Radiation protection, replace picture tube with original type or HITACHI equivalent type.

POWER SOURCE

This television receiver is designed to operate on 120 Volts/60Hz, AC house current. Insert the power cord into a 120 Volts/60Hz outlet.

NEVER CONNECT THE TV TO OTHER THAN THE SPECIFIED VOLTAGE OR TO DIRECT CURRENT.

Service Notes

IMPORTANT: To protect against possible damage to the solid state devices due to arcing or static discharge, make certain that all ground wires and CRT DAG wire are securely connected.

CAUTION: The power supply circuit is above earth ground and the chassis cannot be polarized. Use an isolation transformer when servicing the Receiver to avoid damage to the test equipment or to the chassis. Connect the test equipment to the proper ground (⏚) or (⏚) when servicing, or incorrect voltages will be measured.

WARNING: This Receiver has been designed to meet or exceed applicable safety and X–ray radiation protection as specified by government agencies and independent testing laboratories.

To maintain original product safety design standards relative to X–ray radiation and shock and fire hazard, parts indicated with the symbol ⚠ on the schematic must be replaced with identical parts. Order parts from the manufacturer's parts center using the part numbers shown in this service manual, or provide the chassis number and the part reference number.

For optimum performance and reliability, all other parts should be replaced with components of identical specifications.

Horizontal Oscillator Disable Circuit

This chassis employs a special circuit to protect against excessive high voltage and beam current. If, for any reason, the high voltage and beam current exceed a predetermined level this protective circuit activates and detunes the horizontal oscillator that limits the high voltage.

The over–voltage protection circuit is not adjustable. However, if components indicated by the symbol ⚠ on the schematic in either the horizontal sweep system or the over–voltage protection circuit itself are changed, the operation of the circuit should be checked using the following procedure.

Equipment needed to check the disable circuit:

1. Voltmeter (0 – 200V scale)
2. High Voltage Meter (0 – 40kV)
3. Variac or Isolation Transformer

Procedure:

1. Tune in a station to verify that the horizontal is in sync.
2. Obtain a Monoscope pattern or a signal generator crosshatch pattern.
3. Connect the voltmeter (–) lead to TPD2 and the (+) lead to TPD1 (junction of D555 anode, R556 & R557). Set **Bright** level to (0) and **Picture** for a 1.8 volt reading on the voltmeter.
4. Turn the Receiver OFF. Connect a jumper across IC803 pin 3 and pin 4. Apply +9V DC to cathode of D001.
5. Reduce the AC supply voltage to approximately 45V. Connect the high voltage meter to the CRT anode (H.V. button). **NOTE:** Use the Dag Ground (C10 of the CRT Board) to connect the (–) lead of the meter.
6. Turn the Receiver ON. Slowly increase the AC supply voltage and verify that the high voltage does not exceed **35.5kV for a 20–inch Receiver,** when horizontal just begins to pull out of sync. If the high voltage is not within the specified limit, the cause must be determined and corrected before the Receiver is returned to the customer.

Receiver Feature Table

FEATURE\MODEL	20CX20B501	20CX20B511	20CX20B521
Chassis	NA6L	NA6L	NA6L
# of channels / Phase	181 / PH22M	181 / PH22M	181 / PH22M
Menu language	ENG/SPAN/FR	ENG/SPAN/FR	ENG/SPAN/FR
Closed Caption	X	X	X
75 Ω input	X	X	X
Remote Model #	HL00761	HL00761	HL00761
Picture tube	A51KQN011X	A51KQN011X	A51KQN011X
Black face regular tube	X	X	X
Notch filter	X	X	X
V/A norm switch (X=both)	V	V	V
MTS/SAP/DBX	X	X	X
Built-in audio power	1.5W X 2 (10%)	1.5W X 2 (10%)	1.5W X 2 (10%)
# of speakers	2	2	2
A/V in (rear/front)	1/0	1/0	1/0
Variable audio out	X	X	X
Dimensions mm (WxHxD) In	508.0 x 462.3 x 482.6 20.0 x 18.2 x 19.0	508.0 x 462.3 x 482.6 20.0 x 18.2 x 19.0	508.0 x 462.3 x 482.6 20.0 x 18.2 x 19.0
Weight (kg/lb)	21 / 46.3	21 / 46.3	21 / 46.3
Power soruce (V / Hz)	120 / 60	120 / 60	120 / 60
Power consumption, Max (A)	1.4	1.4	1.4
Anode voltage	27.7kV ± 1.25kV	27.7kV ± 1.25kV	27.7kV ± 1.25kV
Video input jack	$1V_{p-p}$ 75Ω, phono jack	$1V_{p-p}$ 75Ω, phono jack	$1V_{p-p}$ 75Ω, phono jack
Audio input jack	500mV RMS 47kΩ	500mV RMS 47kΩ	500mV RMS 47kΩ
"A"-Board TNP2AH003	CL	CK	CM
"C"-Board TNP2AA005	AB	AB	AB

Table 1. **Receiver Features**

Specifications are subject to change without notice or obligation.
Dimensions and weights are approximate.

Location of Television Controls

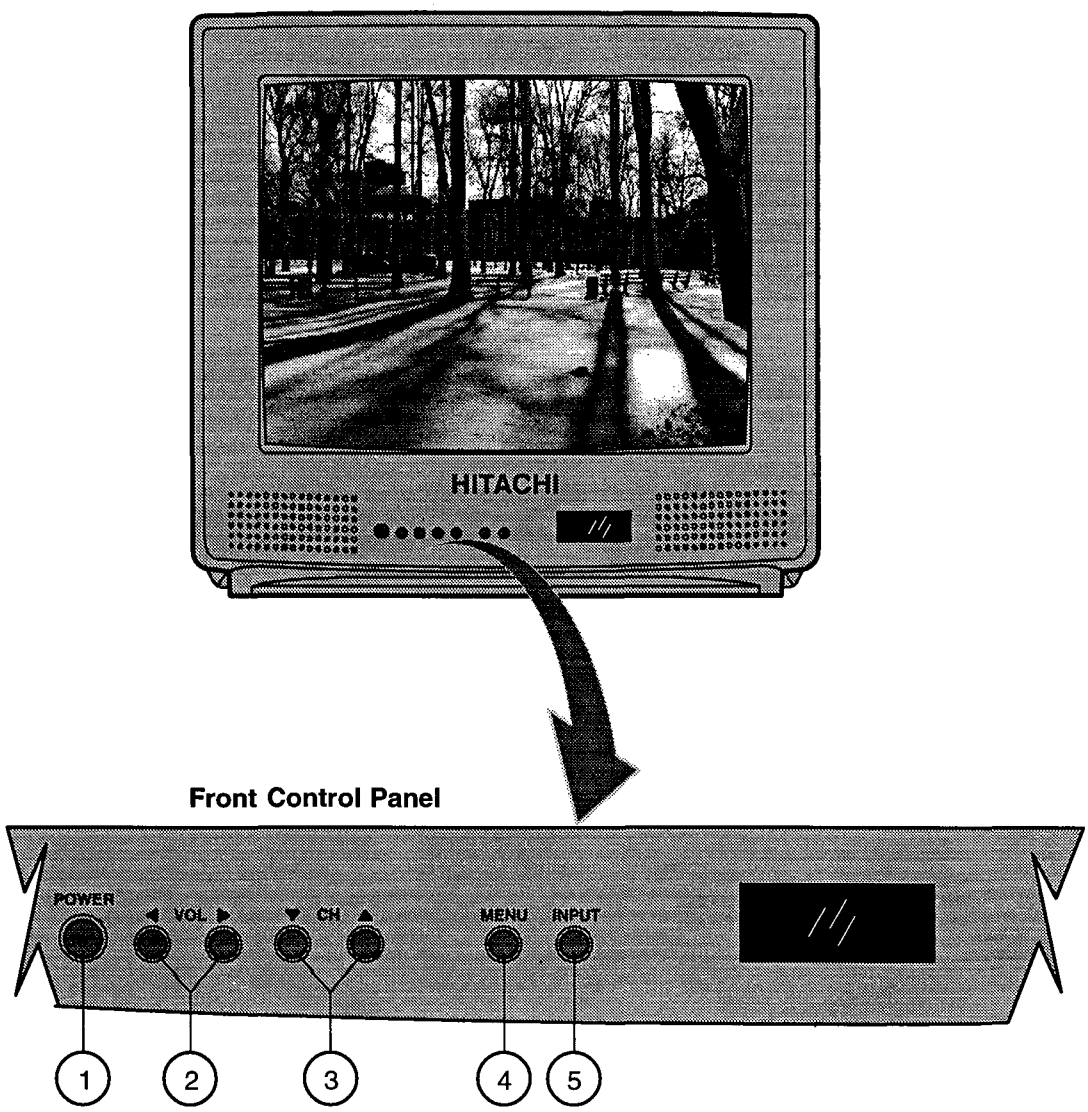


Figure 2. **Location of controls, Front panel**

(1) **Power Button –** Press to turn ON or OFF.

(2) **Vol (Volume) Buttons –** Press to adjust Sound Level.

(3) **Ch (Channel) Buttons –** Press to select programmed channels.

(4) **Menu Button –** Press to display Main Menu and access On Screen features and Adjustment Menus.

(5) **Input Button –** Press to select TV or Video Input.

Button Location on Remote Control

Power Button
Press to turn ON or OFF.

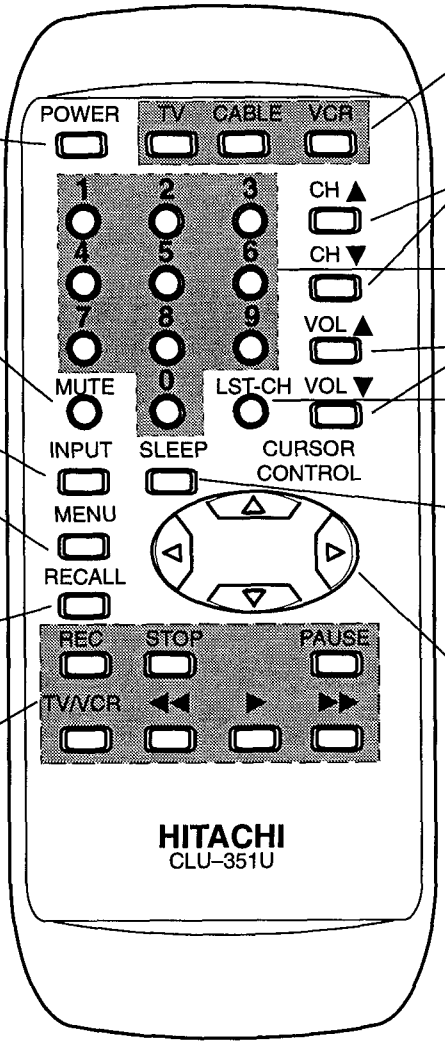
Mute Button
Press to mute sound. A second press resumes sound. Press also to access and delete Closed Caption.

Input Button
Press to select TV or Video Input.

Menu Button
Press to display Main Menu and access or exit On Screen features and Adjustment Menus.

Recall Button
Press to display Time, status of Sleep Timer, Channel, Video Mode, Channel I.D. and Audio Mode.

Precoded VCR Buttons
These buttons transmit the chosen precoded VCR codes.



Mode Buttons
These buttons allow the remote to control your TV, VCR, or Cable Box depending on which mode button is selected.

Channel Buttons
Press to select channels.

Keypad Buttons
Press desired channel number to randomly access any channel.

Volume Buttons
Press to adjust TV sound level.

LST–CH (Last Channel) Button
Press to switch to the previous channel.

Sleep Button
Press to turn TV off in 30, 60, or 90 minutes.

CURSOR Button
Press to adjust Audio menus, Video menus, and select operating features when menus are displayed.

Figure 3. **Location of controls, Remote control**

Using the Remote to Control VCR and Cable Box Functions

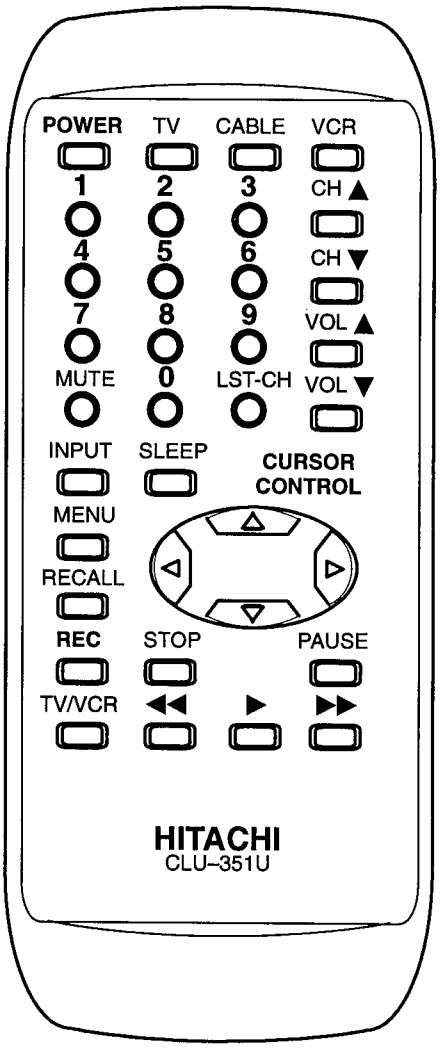
Operating the Precoded Function for Your VCR

This remote is designed to operate different types of VCRs. You must first program the remote to match the remote system in your VCR. (Refer to the VCR Code Index section.)

1. Turn on your VCR.
2. Aim the remote control at the front of your VCR.
3. Press the VCR button to switch to the VCR precoded mode.
4. While holding down the VCR button, enter the 2-digit preset code that matches your VCR.* The remote will turn on your VCR when the correct 2-digit preset code is entered. When this occurs, the remote control is programmed for your VCR. If the VCR does not turn off after 5 seconds, try a different 2-digit preset code.
5. The remote will now control your VCR.

NOTES:

- If your VCR cannot be operated after performing the above procedures, this means that your VCR codes have not been precoded into the remote.
- In the unlikely event that your VCR cannot be operated after performing the above procedures, consult your VCR operating guide.
- The remote control will remember the codes you have programmed in until the batteries are removed from the remote control. After replacing the batteries repeat the entire programming procedure stated above.
- If your VCR does not have a power function, the remote will issue the CHANNEL UP function.



* (Codes are listed on page 10.)

Figure 4. **Remote Control**

Operating the Precoded function for Your Cable Box

1. Turn on your cable box.
2. Aim the remote control at the front of your cable box.
3. Press the cable box button to switch to the cable box precoded mode.
4. While holding down the CABLE button, enter the 2-digit preset code that matches your cable box.* The remote will turn on your cable box when the correct 2-digit preset code is entered. When this occurs, the remote control is programmed for your cable box. If the Cable Box does not turn off after 5 seconds, try a different 2-digit preset code.
5. The remote will now control your Cable Box.

NOTES:

- If your cable box cannot be operated after performing the above procedures, this means that your cable box codes have not been precoded into the remote.
- In the unlikely event that your cable box cannot be operated after performing the above procedures, consult your cable box operating guide.
- The remote control will remember the codes you have programmed in until the batteries are removed from the remote control. After replacing the batteries repeat the entire programming procedure stated above.
- If your cable box does not have a power function, the remote will issue the CHANNEL UP function.
- For some models, the remote control's channel ▲ and ▼ will control the cable box channel. The number buttons will control your television channel although you are in cable mode.

VCR and Cable Box Codes Index

The Remote Control is capable of operating many brands of VCRs and Cable Boxes. You must first program the Remote Control to match the remote system in your VCR or Cable Box.

NOTE: The Remote Control memory is limited. Some models of VCRs or Cable Boxes may not operate. The Remote Control is not designed to control all features that are available in all models.

Code Index For VCRs

VCR Brand	Code(s)
Emerson	00, 01, 10, 16, 23, 33 37, 40, 43
Funai	00
GE	09, 22
Hitachi	00, 14, 15
JVC	14, 26
Magnavox	09, 12, 28
Mitsubishi	16, 23, 26, 45
Panasonic	09, 35, 46
RCA	15, 22
Sony	06, 07, 08, 09
Toshiba	16, 17, 42
Zenith	07, 08, 12,

Code Index For Cable Boxes

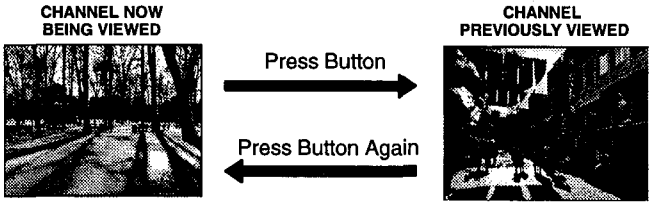
Cable Box Brand	Code(s)
G.I.	09
Jerrold	03, 09, 10, 12, 13, 51
Magnavox	40
Philips	40
Pioneer	39
Samsung	39
Scientific Atlantic	04, 06, 14, 52, 56
Zenith	00

Special Functions

LST-CH

LST-CH – Pressing ◯ will switch between the last two channels selected on the numeric keypad.

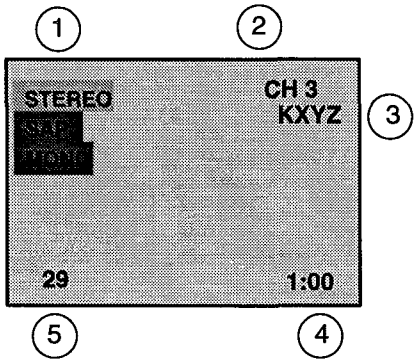
NOTE: When scanning channels with the CHANNEL ▲ or ▼ button, pressing the LST–CH button will switch between the last two channels scanned.



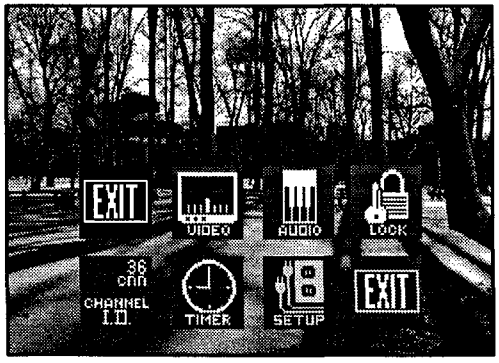
RECALL

Recall – Press ▭ to review:

① Audio Mode Status
② CH Number or Video Input Selected
③ Channel I.D. (Station Identifier)
④ Clock Time
⑤ Sleep Timer Status

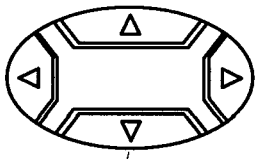


Main Menu



NOTE: When Auto Power On feature is activated, Timer Icon changes to an Exit Icon.

MENU ▭ Display and Exit Menus



Cursor Button ▲ or ▼ Highlight Desired Feature when Menu is Displayed

Cursor Button ◀ or ▶ Selects or Adjusts Features when Menu is Displayed

Cursor Buttons

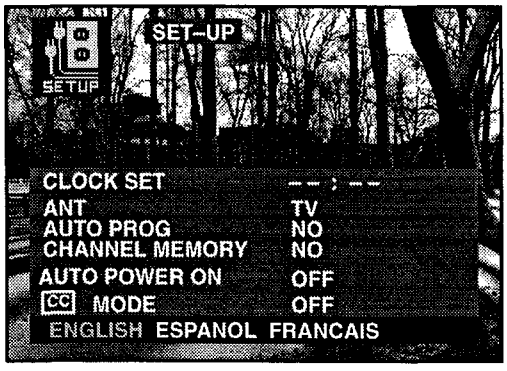
Located On Remote Control

1. Press MENU ▭.
2. Press CURSOR ▲ or ▼ and ◀ or ▶ to select the desired Icon.
3. Press MENU ▭ after selecting the desired Icon to access sub menus.
4. Press MENU ▭ twice to exit sub menus.

Menu Language Selection

The MENU LANGUAGE is factory set to ENGLISH. Follow the instructions to change the Menu Language to SPANISH, FRENCH, and back to ENGLISH.

1. Press MENU ▭.
2. Press CURSOR ▲ or ▼ and ◀ or ▶ to highlight the Set–Up Icon.
3. Press MENU ▭ to display the Set–Up Menu.



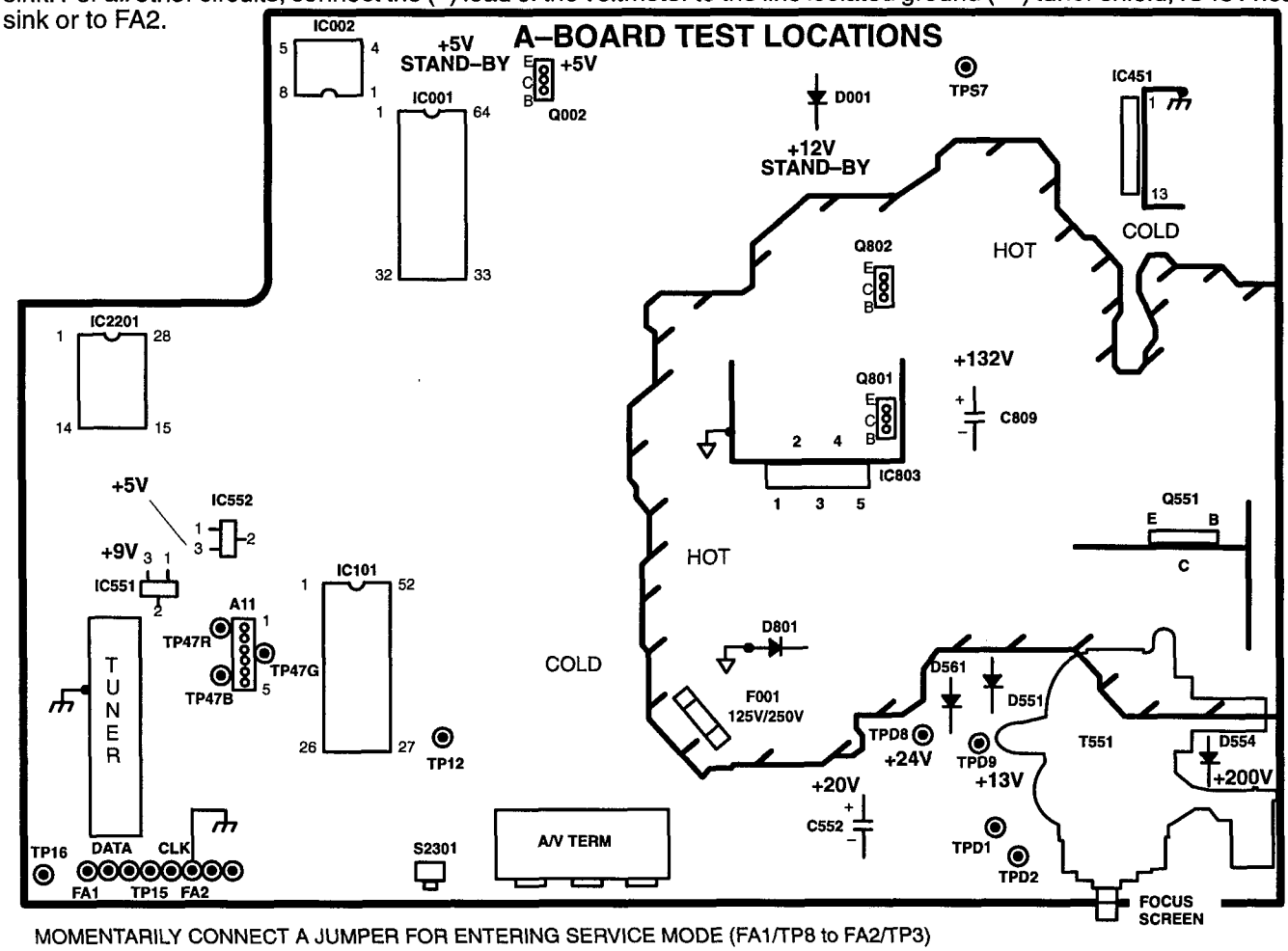
4. Press CURSOR ▲ or ▼ to highlight ENGLISH, ESPAÑOL, FRANÇAIS.
5. Press CURSOR ◀ or ▶ to select ENGLISH, ESPAÑOL, or FRANÇAIS.
6. Press MENU ▭ twice to exit menus.

OPERATION

Chassis Service Adjustment Procedures

All service adjustments are factory preset and should not require adjustments unless controls and/or associated components are replaced.

NOTE: Connect the (–) lead of the voltmeter to the appropriate ground for the circuit being checked. When necessary to use a line operated ground, the ground indication (⏚) is marked. For this ground use anode of D801 or IC803 heat sink. For all other circuits, connect the (–) lead of the voltmeter to the line isolated ground (⏚) tuner shield, IC451 heat sink or to FA2.



MOMENTARILY CONNECT A JUMPER FOR ENTERING SERVICE MODE (FA1/TP8 to FA2/TP3)

132.0V B+ Voltage Confirmation

1. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu.
2. Connect a DVM between C809, + side and Hot ground (⏚).
3. Confirm that B+ voltage is 132.0V±2.5V. This voltage supplies B+ to the Horizontal Output & Flyback circuits.

Source Voltage Chart

120V AC line input. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu . Use cold ground (⏚) for the (–) lead of the DVM.

IC551 pin 3	+9.0V ±0.5V
Cathode of D551 (TPD9)	+13.0V ±2V
C552 (+ side)	+20.0V ±2V
Cathode of D561 (TPD8)	+24.0V ±2V
Cathode of D554	+200V±15V

Adjust Picture menu for normalized video adjustments.

B+ 5V Source Voltages

Volatile 5V:

C572, + side = IC552 pin 3, Tuner BP, IC101 (B+ V_{CC}).

MPU 5V:

Emitter Q002 = IC001(V_{DD}).

Standby 5V:

IC001 (Key in 1), I^2C EEPROM (IC002), TIMER LED, Remote Receiver.

B+ 9V Source Voltage

IC551 pin 3 = IC101 (B+ V_{CC}), Tuner (BM).

B+ 12V (Stand–by) Note: +16V when power is on

Cathode D001 = RL801 (on–off relay), Q002 (+5V Reg).

High Voltage Check

1. Select an active TV channel and confirm that horizontal is in sync.
2. Adjust Brightness and Picture using Picture Icon menu so video just disappears.
3. Confirm B+ 132V is within limit.
4. Using a high voltage meter confirm that the High Voltage is 27.7kV ±1.25kV.

SERVICE

Disassembly for Service

Back Cover

Remove all the screws marked with an arrow (◄) from the back of the Receiver.

Note: screw configuration and number of screws may vary depending on the model of the Receiver serviced; various models are covered in this Manual.

1. 2 screws at the top edge of the Receiver.
2. 1 screw by flyback assembly.
3. 1 screw by the A/V jacks.
4. 2 screws at the bottom edge of the Receiver.

A–Board – Main Chassis

1. Press tab on left rail.
2. Slide the chassis completely out of the guide rails. **NOTE:** Some tie–wraps that secure the wire dressings may need to be unfastened for chassis removal.
3. Stand the Receiver on its edge. The underside of the board is completely accessible for component replacement.

C–Board – CRT Output

Plugs into the socket on the CRT neck.

Keyboard Push Button Assembly

Fastened to the inside of the cabinet front by 3 screws.

Speakers

Secured to the cabinet by 2 screws each.

Disassembly for CRT Replacement

1. Discharge the CRT as instructed in the **Safety Precautions**.
2. Disconnect the yoke plug ,degaussing coil plug and the CRT 2nd anode button from the main board .
3. Remove the C–Board from the CRT base and unplug the black wire (CRT dag ground) C10–1 from the board.
4. Disconnect the A12 and SP plugs from the A–Board.
5. Slide the main chassis assembly completely out with the CRT Board attached.

CRT Replacement

1. Perform **Disassembly for CRT Replacement** procedure.
2. Insure that the CRT H.V. anode button is discharged before handling the CRT. See the **Safety Precautions** on handling the picture tube.
3. Remove the components from the CRT neck and place the cabinet face down on a soft pad.
4. Note the original order of the CRT mounting hardware as they are removed from the CRT mounting brackets at each corner of the CRT.
5. Remove the CRT with the degaussing coil and the dag ground braid attached.
6. Note the original locations and mounting of the degaussing coil and the dag ground assembly to insure proper reinstallation on the replacement CRT.

   To remove and re–mount the degaussing coil:
   The degaussing coil is held in place by clampers fastened to the CRT corner ears.
   These clampers must be installed onto the replacement CRT prior to mounting the degaussing coil.

   To remove and re–mount the dag ground braid:
   - Unhook the coil spring from the upper right CRT ear.
   - Release the braid loop from the upper left and the lower right CRT ear.
7. Mount the dag ground braid on the replacement CRT. Position the degaussing coil with new ties. Dress coil as was on the original CRT.
8. Replace the components on the CRT neck and re–install into cabinet. Verify that all ground wires and circuit board plugs get connected.

Purity and Convergence Procedure

Adjustment is necessary only if the CRT or the deflection yoke is replaced or if the setting was disturbed. The complete procedure consists of:

1. Initial static convergence.
2. Setting the purity.
3. Final static convergence.

When the CRT or the Yoke is Replaced

Place the yoke on the CRT neck (do not tighten the clamp).

For a 2–piece assembly (see Figure 5):

Position purity/convergence assembly as shown and tighten clamp snugly. Cut the hot–melt glue seal on assembly and place like tabs of purity device together at 12 o'clock to reduce its magnetic field effect. Manually degauss the CRT.

Turn the Receiver ON and slide the deflection yoke back and forth on the neck of the CRT. Stop at the position that produces a near white, uniform raster.

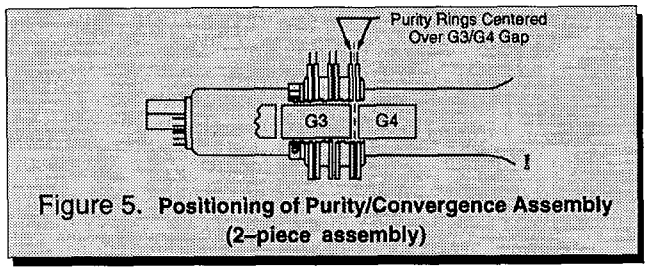


Figure 5. **Positioning of Purity/Convergence Assembly (2–piece assembly)**

For a 1–piece assembly (see Figure 6):

Place like tabs of purity devices together at 12 O'Clock to reduce any magnetic field effect. Manually degauss the set.

Connect a Black/White pattern generator and tune the receiver to the signal. Slide the deflection yoke & purity ring assembly back and forth on the CRT neck. Stop at a position that produces a near white signal.

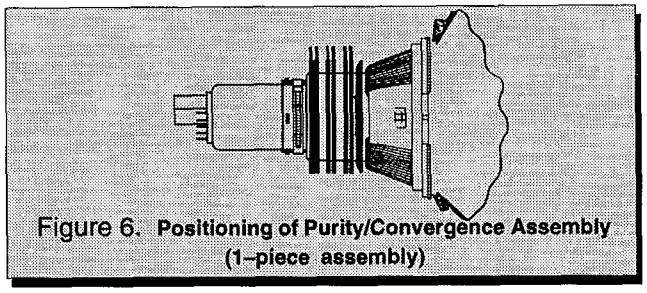


Figure 6. **Positioning of Purity/Convergence Assembly (1–piece assembly)**

Initial Center Static Convergence

Connect a dot/crosshatch generator to the Receiver and tune in signal. Observe misconvergence at center of the screen only.

Adjust the 4 pole magnet (center rings); separate tabs and rotate to converge blue with red.

Adjust the 6 pole magnet (rear rings): separate tabs and rotate to converge blue and red (magenta) with green.
Note: *Precise convergence at this point is not important.*

Purity Adjustment

When the Receiver is in the Serviceman Mode for making electronic adjustments, press the **Recall** button on the Remote Control to enter Purity Check. (See **Service Adjustments Electronic Controls**.)

Operate the Receiver for 60 minutes using the first Purity check field (white screen) to stabilize the CRT.

Fully degauss the Receiver by using an external degaussing coil.

Press the **Recall** button on the Remote Control again until the Purity Check (green screen) appears.

For a 2–piece assembly (see Figure 5):

Loosen the deflection yoke clamp screw and move the deflection yoke back as close to the purity magnet as possible.

Adjust the purity rings to set the vertical green raster precisely at the center of the screen (see Figure 7).

NOTES:
1. CRT warm up with white screen (three guns activated) is needed to stabilize the shadow mask expansion.
2. Initial center static convergence (roughly centers three gun beams) is required in order to perform purity adjustment.

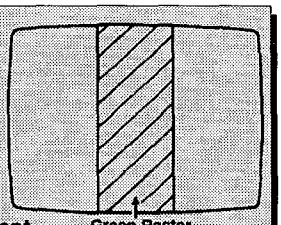


Figure 7. **Green Raster Adjustment**

Slowly move the deflection yoke forward until the best overall green screen is displayed.

For a 1–piece assembly (see Figure 6):

Slowly move the deflection yoke and purity rings assembly toward the CRT board and adjust the purity magnet rings to set vertical green raster at center of screen (see Figure 7).

Gradually move the deflection yoke & purity rings forward and adjust for the best overall green screen.

Continue from here for either assemblies:

Tighten the deflection yoke clamp screw.

Press the **Recall** button on the Remote Control again until the Purity Check (blue screen) and (red screen) appear and observe that good purity is obtained on each respective field.

Press the **Recall** button on the Remote Control again until Purity check (white screen) appears. Observe the screen for uniform white. If purity has not been achieved, repeat the above procedure.

Final Convergence Procedure (see Figure 8 through Figure 10):

Note: *Vertical size and focus adjustments must be completed prior to performing the convergence adjustment. Connect a dot pattern generator to the Receiver. The* ***Brightness*** *level should not be higher than necessary to obtain a clear pattern.*

Converge the red and blue dots at the center of the screen by rotating the 4 pole (R with B) Static Convergence Magnets.

Align the converged red/blue dots with the green dots at the center of the screen by rotating the 6 pole (R/B with G) Static Convergence Magnets. Melt wax with soldering iron to reseal the magnets.

SERVICE

Slightly tilt vertically and horizontally (do not rotate) the deflection yoke to obtain a good overall convergence.

If convergence is not reached at the edges, insert permalloy (see following section) from the DY corners to achieve proper convergence. Recheck for purity and readjust if necessary.

After vertical adjustment of the yoke, insert wedge at 11 o'clock position, then make the horizontal tilt adjustment.

Secure the deflection yoke by inserting two side wedges at 3 and 7 o'clock positions.

Apply adhesive between tab (thin portion) of wedge and CRT and place tape over the tab to secure to the CRT.

Permalloy Convergence Corrector Strip (Part No. OFMK014ZZ)

This strip is used in some sets to match the yoke and CRT for optimum convergence. If the yoke or CRT is replaced, the strip may not be required.

First converge the set without the strip and observe the corners.

If correction is needed:

1. Place strip between CRT and yoke, in quadrant needing correction. Slowly move it around for desired results.
2. Press adhesive tightly to the CRT and secure with tape.

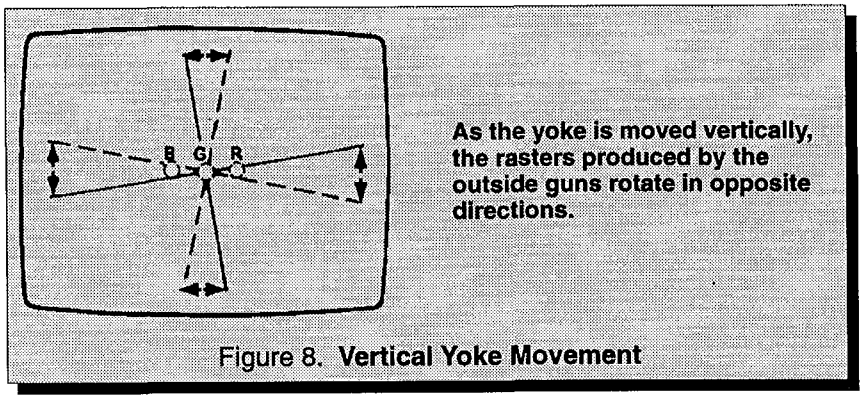


Figure 8. **Vertical Yoke Movement**

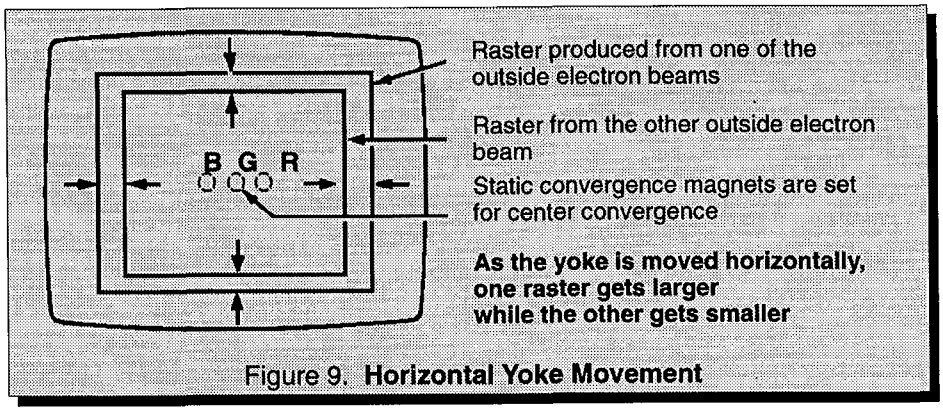

B G R
Raster produced from one of the outside electron beams
Raster from the other outside electron beam
Static convergence magnets are set for center convergence
As the yoke is moved horizontally, one raster gets larger while the other gets smaller

Figure 9. **Horizontal Yoke Movement**

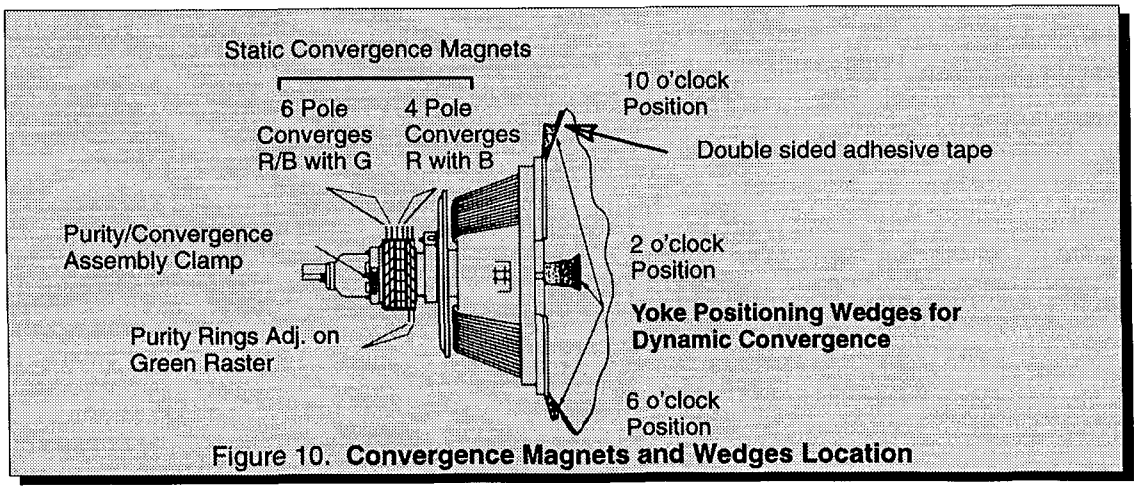

Static Convergence Magnets
6 Pole Converges R/B with G
4 Pole Converges R with B
10 o'clock Position
Double sided adhesive tape
Purity/Convergence Assembly Clamp
2 o'clock Position
Yoke Positioning Wedges for Dynamic Convergence
Purity Rings Adj. on Green Raster
6 o'clock Position

Figure 10. **Convergence Magnets and Wedges Location**

SERVICE

Serviceman Mode (Electronic Controls)

This Receiver has electronic technology using the I^2C Bus Concept. It performs as a control function and it replaces many mechanical controls. Instead of adjusting mechanical controls individually, many of the control functions are now performed by using the "On Screen Display Menu". (The **Serviceman Adjustment Mode.**)

Note: *It is suggested that the technician reads all the way through and understand the following procedure for Entering/Exiting the* ***Serviceman Adjustment Mode****; then proceed with the instructions working with the Receiver. When becoming familiar with the procedure, the Flow Chart for Serviceman Mode may be used as a quick guide.*

Entering Serviceman Mode:

At times when minor adjustments need to be done to the electronic controls, the method of Entering the Serviceman Mode without removal of the cabinet back is as follows using the Remote Control:

1. Select SET–UP icon and select CABLE mode.
2. Select TIMER Icon and set SLEEP timer for 30.
3. Press ACTION button twice to exit Menus.
   Tune to Channel 124.
   Adjust VOLUME to Minimum (0).
   On Receiver press the VOL ◄ button (decrease). Red "CHK" appears in upper corner.

To toggle between Aging and Serviceman modes:

While the "CHK" is displayed on the left top corner of the CRT, pressing the **Action** and the **Volume Down** buttons on the Receiver simultaneously will toggle between the modes (red "CHK" for Serviceman; yellow "CHK" for Aging).

4. **Press** the **Power** button on the Remote Control to select one of five Serviceman Adjustment Modes.
   1) B = Serviceman VCJ SUB ADJUSTMENTS
   2) C = Serviceman VCJ CUT–OFF ADJUSTMENTS
   3) S = Serviceman OPTIONS (PIP and CLOCK) ADJUSTMENTS
   4) M = Serviceman MTS ADJUSTMENTS
   5) "CHK" = Normal operation of CHANNEL ▲▼ and VOLUME ◄►

SERVICE

Note: *Only the applicable settings for the Receiver serviced will be available (see a in Figure 11).*

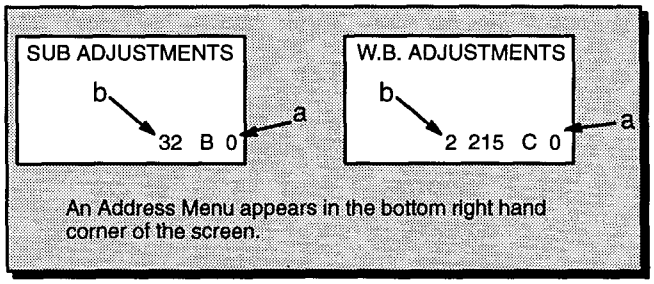


Figure 11. **Serviceman Mode Menu Adjustments**

For DAC Adjustments:

1. **Press**
   Channel Up/Down on the Remote Control to select one of the 8 available Service Adjustments (a in Figure 11).

   Important Note: *Write down the original value set (b in Figure 11) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press**
   Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).

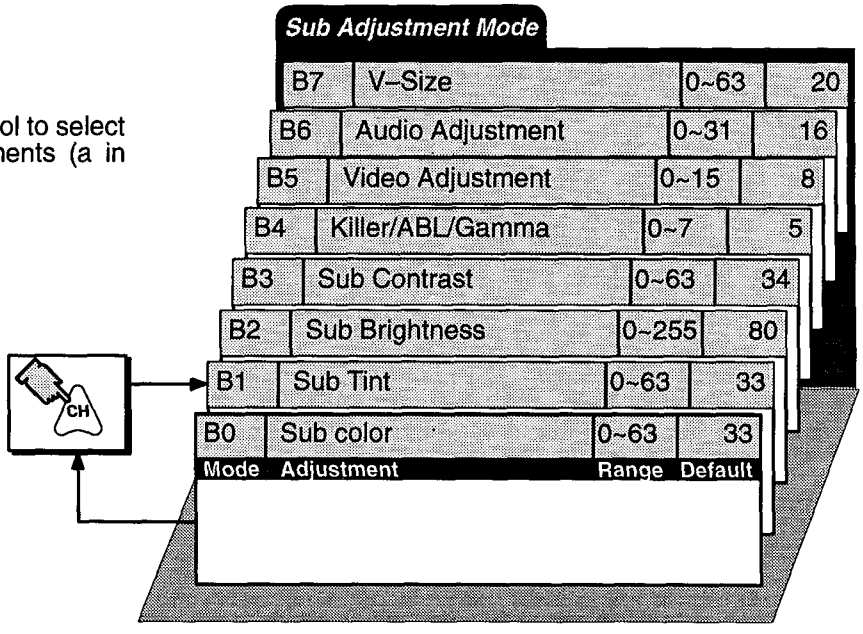

Sub Adjustment Mode
B7 V–Size 0~63 20
B6 Audio Adjustment 0~31 16
B5 Video Adjustment 0~15 8
B4 Killer/ABL/Gamma 0~7 5
B3 Sub Contrast 0~63 34
B2 Sub Brightness 0~255 80
B1 Sub Tint 0~63 33
B0 Sub color 0~63 33
CH
Mode Adjustment Range Default

Figure 12. **Sub Adjustment Mode**

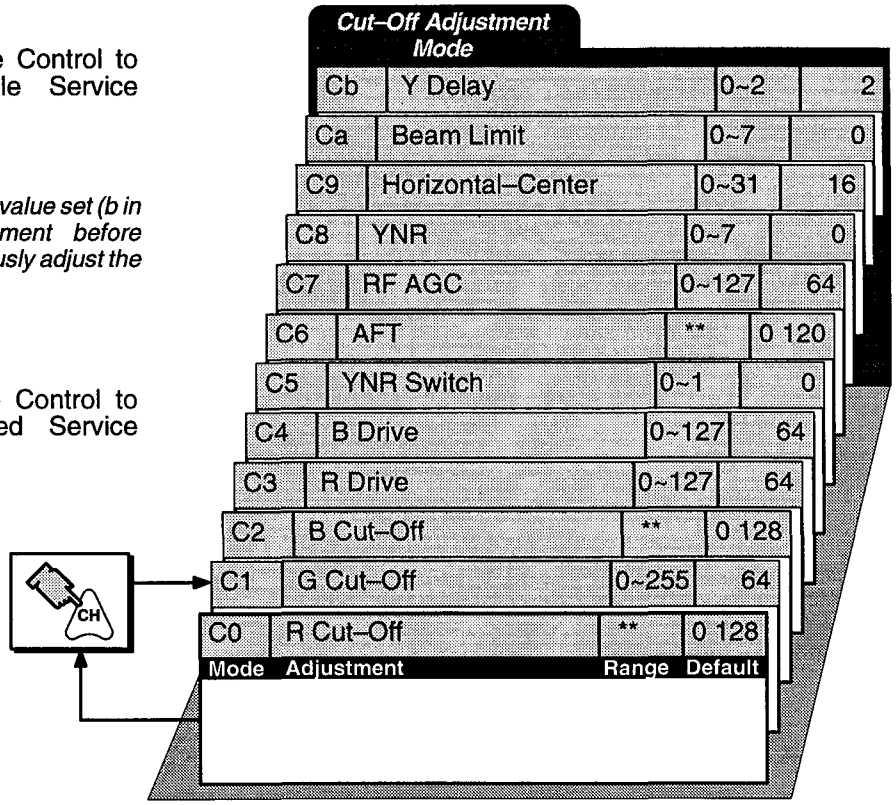
Press the **Power** button on the Remote Control to select the Serviceman White Balance Adjustment Mode.

For VCJ Cut–Off Adjustments:

1. **Press Channel Up/Down** on the Remote Control to select one of the 12 available Service Adjustments (a in Figure 11).

   Important Note: *Write down the original value set (b in Figure 11) for each address adjustment before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press Volume Up/Down** on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).


Cut–Off Adjustment Mode
Cb Y Delay 0~2 2
Ca Beam Limit 0~7 0
C9 Horizontal–Center 0~31 16
C8 YNR 0~7 0
C7 RF AGC 0~127 64
C6 AFT ** 0 120
C5 YNR Switch 0~1 0
C4 B Drive 0~127 64
C3 R Drive 0~127 64
C2 B Cut–Off ** 0 128
C1 G Cut–Off 0~255 64
C0 R Cut–Off ** 0 128
Mode Adjustment Range Default
CH

** ***Note:*** *Range is in steps:*
0 0 ~ 0 255
1 0 ~ 1 255

Figure 13. **White Balance Adjustment Mode**

Press the **Power** button on the Remote Control to select the Serviceman MTS Adjustment Mode.

For Options (PIP and CLOCK) Adjustments:

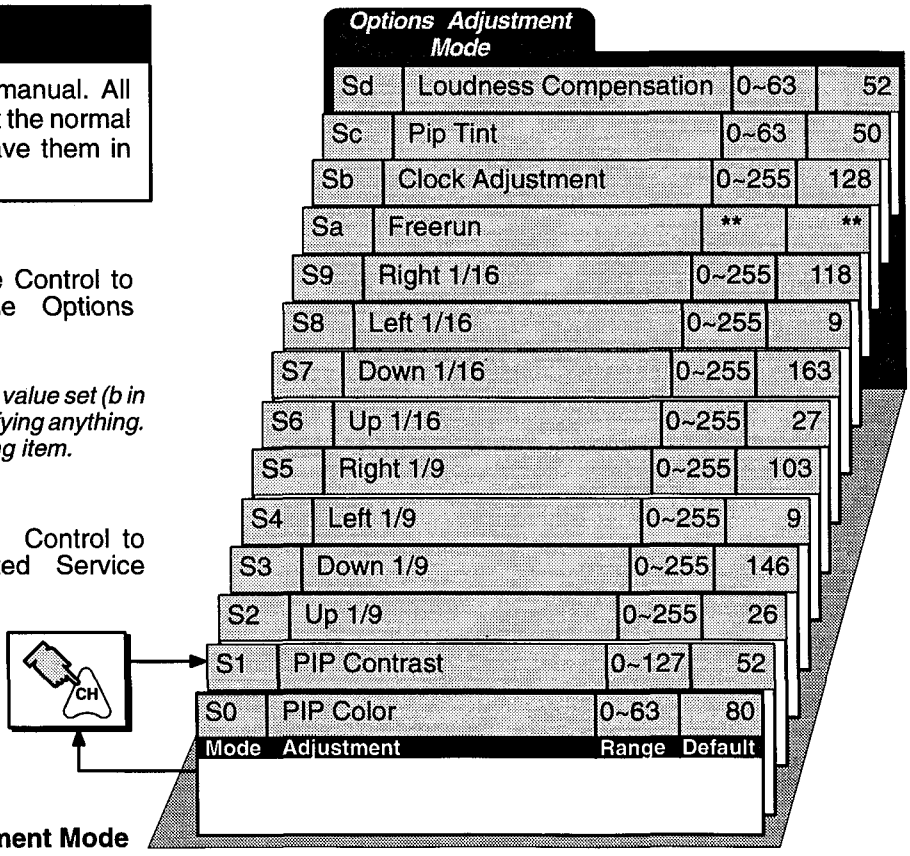
IMPORTANT

Only items "Sb" and "Sd" pertain to this manual. All other settings in this group will not affect the normal operation of the Television (please leave them in their default state).

1. **Press Channel Up/Down** on the Remote Control to select one of the 12 available Options Adjustments (a in Figure 11).

   Important Note: *Write down the original value set (b in Figure 11) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press Volume Up/Down** on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).


Options Adjustment Mode
Sd Loudness Compensation 0~63 52
Sc Pip Tint 0~63 50
Sb Clock Adjustment 0~255 128
Sa Freerun ** **
S9 Right 1/16 0~255 118
S8 Left 1/16 0~255 9
S7 Down 1/16 0~255 163
S6 Up 1/16 0~255 27
S5 Right 1/9 0~255 103
S4 Left 1/9 0~255 9
S3 Down 1/9 0~255 146
S2 Up 1/9 0~255 26
S1 PIP Contrast 0~127 52
S0 PIP Color 0~63 80
Mode Adjustment Range Default
CH

** ***Factory only***

Figure 14. **Options Adjustment Mode**

SERVICE

Press the **Power** button on the Remote Control to select the Serviceman MTS Adjustment Mode.

For MTS Adjustments:

1. **Press**
   Channel Up/Down on the Remote Control to select one of the 5 available MTS Adjustments (a in Figure 11).

   Important Note: *Write down the original value set (b in Figure 11) for each address before modifying anything. It is easy to erroneously adjust the wrong item.*

2. **Press**
   Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (b in Figure 11).

3. Press the **POWER** button on the remote control to loop back to setting of the SUB ADJ Mode.

   OR

   Press **ACTION** and **POWER** buttons on the Receiver simultaneously for at least 2 seconds to return the Receiver to normal mode (exit Serviceman Mode).

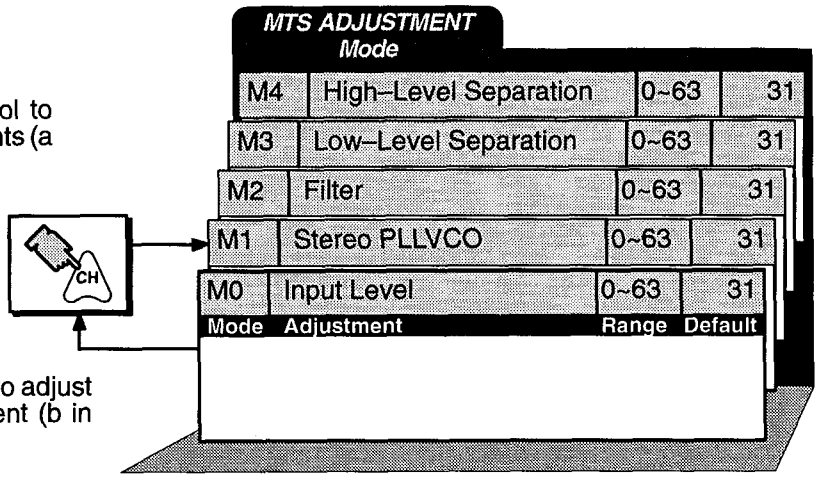


Figure 15. **MTS Adjustment Mode**

To Check Purity:

Press the **Recall** button on the Remote Control when in Serviceman Modes (red "CHK" is displayed) to enter the Purity Field Check Mode.

Note: *The Receiver must be in the Serviceman Mode to display color.*

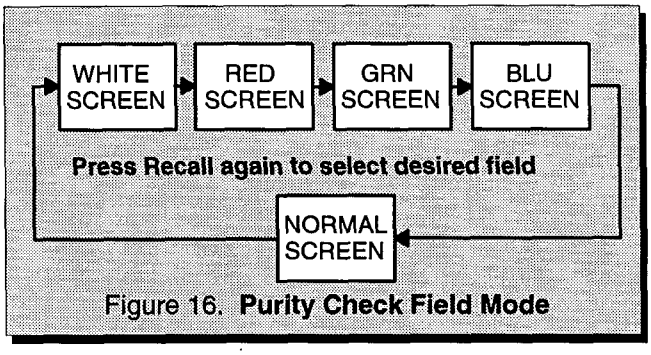


Figure 16. **Purity Check Field Mode**

SERVICE

IMPORTANT NOTE:
Always Exit the Serviceman Mode following Adjustments.

Exiting the Serviceman Mode:

Press the **Action** and the **Power** buttons on the Receiver simultaneously for at least 2 seconds.
"The Receiver exits Serviceman Mode".
The Receiver momentarily shuts off; then comes back on tuned to channel 3 with a preset level of sound.

Helpful Hints

Entering Serviceman Mode (Other Method – back open):

1. While the Receiver is ON and operating in Normal Mode, momentarily short test point FA1 to cold ground (⏚) FA2 (A–Board: TP pin 8 to pin 3).
   "The Receiver enters the Aging Mode".
   Yellow letters "CHK" appear in the upper left corner of the CRT.
   (The Volume Up/Down will adjust rapidly.)
2. Simultaneously **press** the **Action** and the **Volume Up** buttons on the Receiver Control Panel.
   "The Receiver enters the Serviceman's Mode".
   The letters in "CHK" turn red.
   (The Volume Up/Down will adjust normally.)
   (All customer controls are set to a nominal level.)

Notes

Instructional Flow Chart for Serviceman Mode

Caution: Always EXIT Serviceman Mode

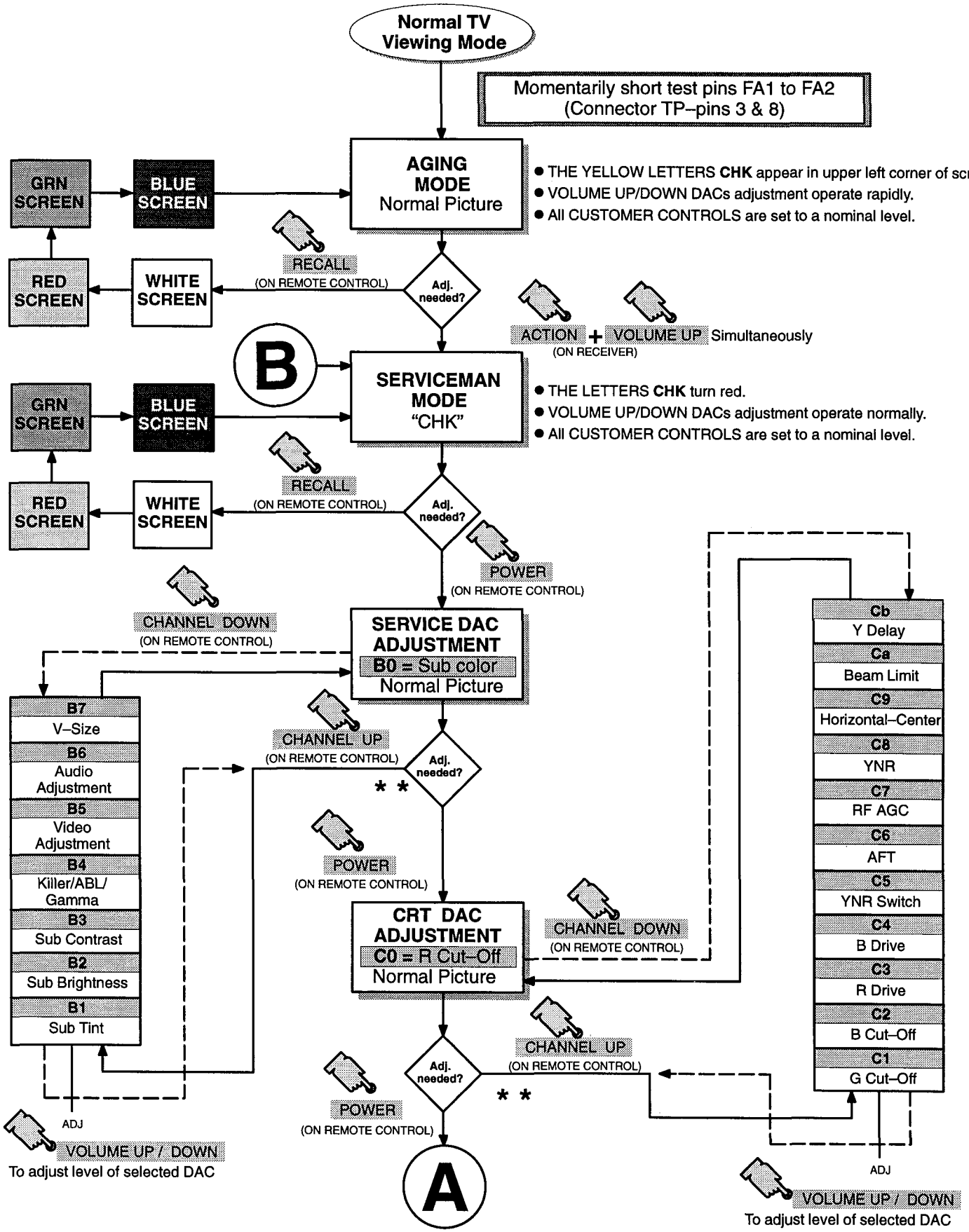


Figure 17. **Flow Chart for Serviceman Mode**

Instructional Flow Chart for Serviceman Mode – Continued

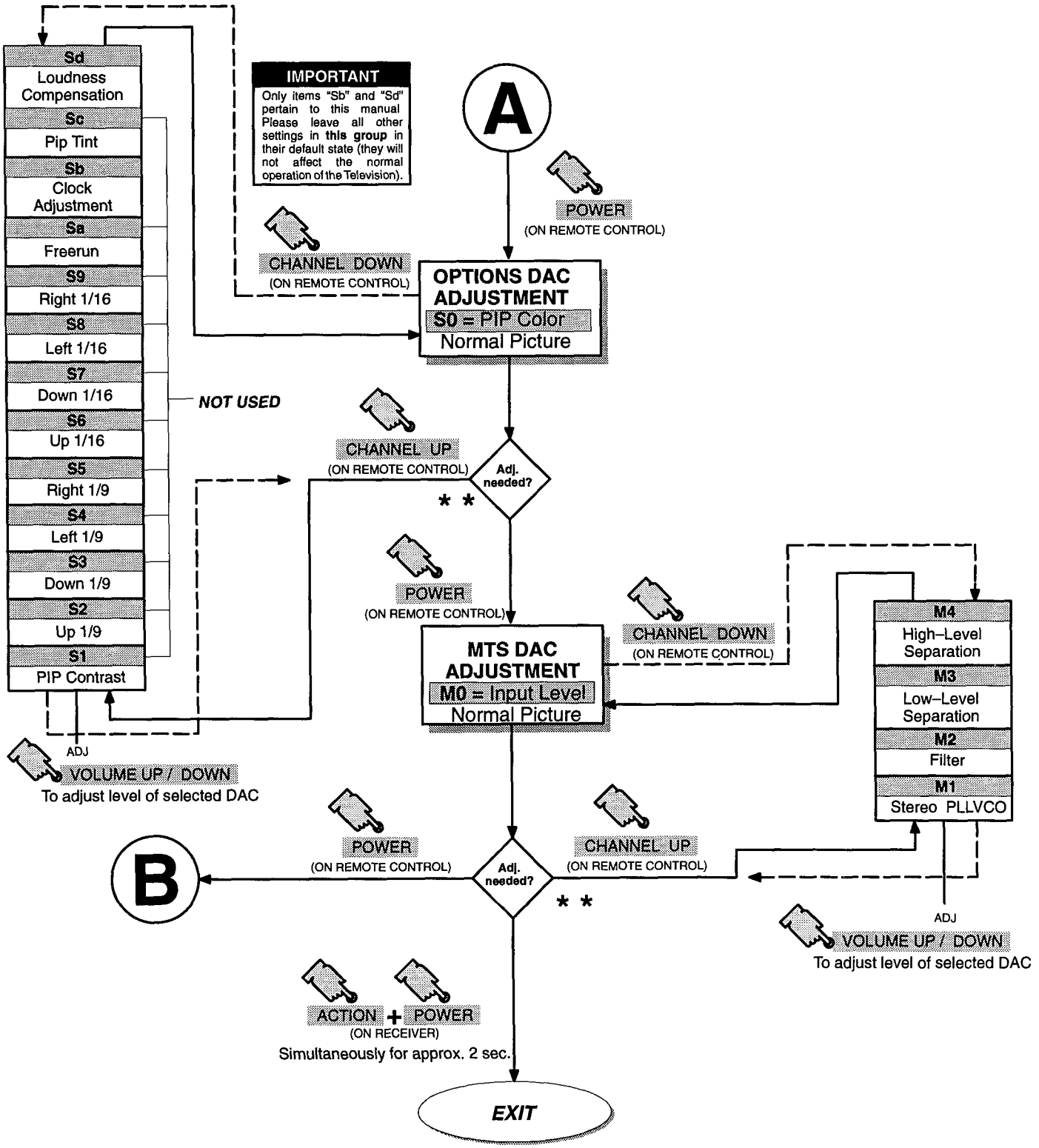


Figure 18. **Flow Chart for Serviceman Mode (Continued)**

Note: When *EXITING*, the Receiver shuts off; then turns on, TUNED TO CHANNEL 3 WITH A PRESET SOUND LEVEL.

Any Programmed Channels, Channels Caption data and some other user defined settings will be erased.

**** * Important Note***

Before making any DAC adjustments note the existing values!

SERVICE

Service Adjustments (Electronic Controls)

Video Adjustment Level

Serviceman DAC Adjustment (B5)

Preparation:

1. Obtain an NTSC color bar pattern with 100 IRE white and 87.5% modulation.
2. Connect the oscilloscope to TP12. Use cold ground for scope connection. Set the scope at Horizontal Sweep rate (20µs) time base.

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Video Adjustment Level (B5) and adjust for 1.0V ±0.05V from sync tip to white level. See Figure 19.

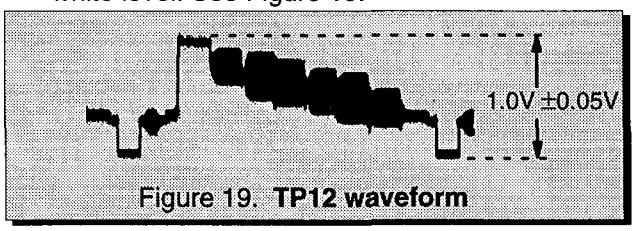


Figure 19. **TP12 waveform**

2. Set the DAC Sub–Contrast Adjustment (B3).

Sub–Contrast

Serviceman DAC Adjustment (B3)

This adjustment is factory set. **Do not adjust** unless repairs are made to associated circuits, the CRT Board, or when the CRT is replaced.

Preparation:

1. Apply a color bar signal pattern with 87.5% modulation, 70% saturated color bar with a 100 IRE white and 7.5 black.

NOTE: The pattern used in this procedure is an EIA color bar pattern with 87.5% modulation with 100 IRE white and 7.5 black. Correlate the information in this procedure to the pattern used if another signal is used.

2. Preset the following controls:
   - Brightness ..... Center
   - Color ..... Min
   - Picture ..... Max.
   - Sharpness ..... Center
3. Connect the oscilloscope to the CRT–Board connector C1–2. Set the scope time base to 20µs (horizontal).
4. Connect a jumper from TPD2 to ground (⏚)
5. Connect a jumper from IC101 pin 28 to ground (⏚).

Procedure:

1. In the Serviceman Mode for electronic adjustments, select DAC Sub–Brightness Adjustment (B2) and adjust for 1.0–1.5Vp–p between blanking and 7.5 IRE level so that the black level cannot be compressed. (see video waveforms detail, Figure 20).
2. In the Serviceman Mode for electronic adjustments, select DAC Sub–Contrast Adjustment (B3) and adjust for 2.8Vp–p ±0.1V from white level to black level on video waveform (see video waveforms detail, Figure 20).

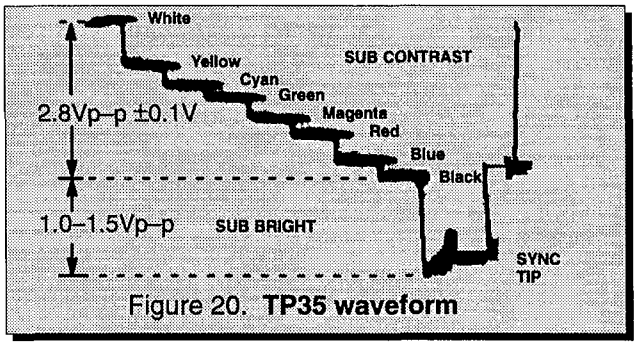


Figure 20. **TP35 waveform**

3. Remove the jumpers (Preparation steps 4 and 5).

Tint/Color Adjustment

Serviceman DAC Adjustment (B1) (B0)

Preparation:

1. Apply a rainbow color bar signal.
2. Preset the following controls:
   - Brightness ..... Min.
   - Color ..... Center
   - Picture ..... Max.
   - Sharpness ..... Min
   - Tint ..... Center
3. Connect the oscilloscope to TP47B (A–Board) or to connector C1 pin 3.
4. Connect a jumper from TPD2 to GND (⏚).
5. Connect a jumper from IC101 pin 28 to ground (⏚).

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Sub–Tint Adjustment (B1). Adjust until the waveform measured is as the one shown in Figure 21.

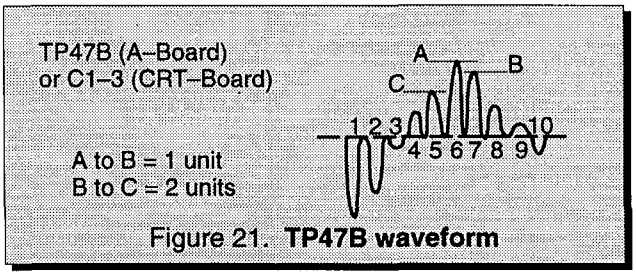


Figure 21. **TP47B waveform**

2. Connect the oscilloscope to TP47G (A–Board) or to connector C1 pin 2 (CRT–Board).
3. Select DAC Sub–Color Adjustment (B0) and adjust for peak to peak amplitude to be 0.8V p–p ±0.05V (Figure 22).

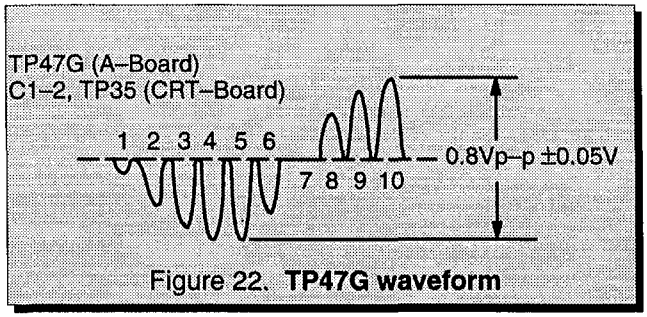


Figure 22. **TP47G waveform**

4. Remove the jumpers (Preparation steps 4 and 5).

SERVICE

Service Adjustments (Electronic Controls,cont.)

Color Temperature Adjustment (B/W Tracking)

Serviceman DAC Adjust. (C0) (C1) (C2) (C3) (C4)

Minor Touch–Up Method

OBSERVE low and high brightness areas of a B/W picture for proper tracking. Adjust only as required for "good grey scale and warm highlights".

1. LOW LIGHT areas – In Serviceman Mode for making electronic adjustments, select Cutoff (C0) RED, (C1) GRN, (C2) BLU and adjust the picture for grey.
2. HIGH LIGHT areas – In Serviceman Mode for making electronic adjustments, select Drive (C3) RED, (C4) BLU and adjust the picture for warm whites.

Complete Adjustment

Preparation:

1. Turn the Receiver "ON" and allow 10 minutes warm up at high brightness.
2. Apply a color bar signal with color "OFF".
3. Turn the SCREEN control (part of FBT T551) fully counterclockwise.

Procedure:

Preset the following Serviceman DAC's for the best results.

- C0 ..... 0 128
- C1 64
- C2 ..... 0 128
- C3 64
- C4 64

1. Connect the oscilloscope to C1–2 (CRT–Board).
2. In Serviceman Mode for making electronic adjustment, select the Sub–Bright DAC (B2).
3. Press the R–Tune key on the remote.
4. Observe the oscilloscope waveform at Horizontal rate and adjust the Serviceman Mode Sub–Bright DAC (B2) level until a scanning period of 3.0V above DC ground is measured, as indicated in Figure 23.

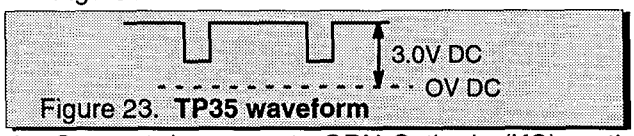


Figure 23. **TP35 waveform**

5. Connect the scope to GRN Cathode (KG) on the CRT–Board.
6. In the Serviceman Mode for making electronic adjustments, select the GREEN CUTOFF DAC (C1).
7. Press the R–Tune key on the remote.
8. View scope trace at Horizontal rate and adjust the Serviceman Mode DAC (C1) level until a scanning period of 175V above DC ground is measured, as indicated in Figure 24.

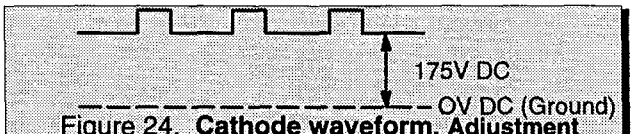


Figure 24. **Cathode waveform, Adjustment Waveform Detail (Steps 8, 12 & 16)**

9. Connect the scope to the RED Cathode (KR).
10. In Serviceman Mode for making electronic adjustments, select the RED CUTOFF DAC (C0).
11. Press the R–Tune key on the remote.
12. View the scope trace and adjust the Serviceman Mode DAC (C0) for the scanning period to be 175V above DC ground. (See Figure 24)
13. Connect the scope to the BLU Cathode (KB).
14. In Serviceman Mode for making electronic adjustments, select the BLU CUTOFF (C2).
15. Press the R–Tune key on the remote.
16. View the scope trace and adjust the Serviceman Mode DAC (C2) for the scanning period to be 175V above DC ground. (See Figure 24)
17. Turn the Screen Control (part of FBT) slowly clockwise until a color horizontal line appears.
18. With the other two colors Serviceman Mode DAC CUTOFF adjustments (C0) RED, (C1) GRN, (C2) BLU; increase the colors to create a white horizontal line.
19. Confirm that a good gray scale is established by viewing B/W color bar pattern.
20. In the Serviceman Mode for making electronic adjustments select the DAC DRIVE adjustments (C3) RED, (C4) BLU and adjust for warm white in a white color bar pattern.
25. EXIT the Serviceman Mode.
26. Adjust the Picture Menu Video Adjustments **Bright** and **Picture** from low scale to high scale and check Black and White tracking.
27. If correction is needed: Re–Enter the Serviceman Mode and perform the **Minor Touch – Up Method.**
28. Perform **Sub–Brightness** Adjustment procedure.

Sub–Brightness

Serviceman DAC Adjustment (B2)

Adjustment of this control is important for setting proper operation of customer brightness and picture controls. This adjustment must be made after Sub–Contrast or Color Temperature adjustments are made. **Do not adjust** SCREEN after the Sub–Brightness is set.

Preparation:

1. Apply a color bar signal with 100 IRE white and 7.5 IRE black. (Switch Color to "OFF" on the signal generator.) Operate the Receiver for a minimum of 10 minutes prior to performing this adjustment.
2. Preset the following controls:
   - Color ..... Center
   - Picture ..... Max.
   - Tint ..... Center

Procedure:

In the Serviceman Mode for making electronic adjustments, select the DAC adjustment (B2) and adjust until the black bar starts to look grey. Then decrease the level to the point where grey turns to black.

SERVICE

Service Adjustments (Electronic Controls,cont.)

Horizontal Centering

Serviceman DAC Adjustment (C9)

Preparation:

Connect a crosshatch generator.

Procedure:

1. In the Serviceman Mode for making electronic adjustments. Select the Horizontal Centering Adjustment DAC (C9) and adjust until the center of the crosshatch pattern is centered on CRT.
2. EXIT the Serviceman Adjustment Mode.

Audio Adjustment

Serviceman DAC Adjustment (B6)

This adjustment is factory set and needs to be performed only when IC002 or IC101 is replaced.

Preparation:

1. Apply the following signal at the antenna (70dB ±5dB, 75Ω open P/S 10dB): audio signal set to monaural, 300Hz. 100% modulation; video input of 100 IRE flat field, 30% modulation.
2. Connect the RMS Meter with filter jig as shown in Figure 25.

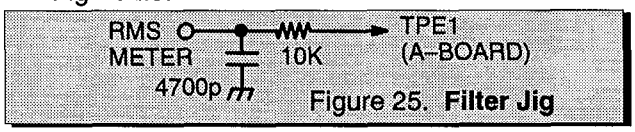


Figure 25. **Filter Jig**

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select the Audio Adjustment DAC (B6) and adjust until the RMS meter reading are: 150mV RMS ±7.5mV RMS
2. EXIT the Serviceman Adjustment Mode.

Clock Adjustment (Sb)

Preparation:

Connect the frequency counter from TPS1 (IC001 Pin 13) to cold ground (⏚).

NOTE: Frequency Counter probe capacitance should be 8pF or less.

Procedure:

1. Turn the Receiver "OFF" with the AC power applied.
2. Measure TPS1 (IC001 pin 13) for the frequency of the waveform and record the reading.

   Note: Pin 13 measurement must have at least four digits of resolution following the decimal point Example: 000.0000
3. Turn the Receiver "ON".
4. Place the Receiver into Serviceman Mode for making electronic adjustment, select the Clock Adjustment DAC (Sb).
5. Calculate and set Sb based on the following formula:

$$Sb = 128 + 0.901 \times 10^6 \times \frac{\{244.1406 - \text{pin 13 [Hz]}\}}{244.1406}$$

NOTE: Pin 13 measurement will not change regardless of the value stored in Sb.

Vertical Size (B7)

1. Adjust the VERTICAL SIZE DAC control, B7, until the top and the bottom edges of the raster are visible.
2. Adjust the VERTICAL SIZE control B7, until the top and the bottom of the raster touch the bezel edge. Then advance SIZE control to obtain an approximately 10% overscan. Linearity adjustment is done automatically when the size is being adjusted. (Best results can be obtained with a round test pattern.)

SERVICE

Service Adjustments (Mechanical Controls)

VCO Field Alignment L105

1. Connect a balance antenna and select a midband channel (Ch 10, 11 or 12)
2. Attenuate the signal strength for a weak noisy video.
3. While observing the picture tube, adjust L105 until best picture appears.
4. Change channels and observe that they are tuning properly.
5. If the channel monitored is not clear, repeat steps 1, 3 and 4 while applying a stronger signal.

Focus (Part of T551)

Preparation:

Connect a Signal generator and select a dot pattern.

Procedure:

Adjust the FOCUS control to obtain the sharpest and clearest dot pattern.

a. adjust for best center.
b. adjust for best area between the center and top right corner.

Notes

Audio Signal Path Block Diagram

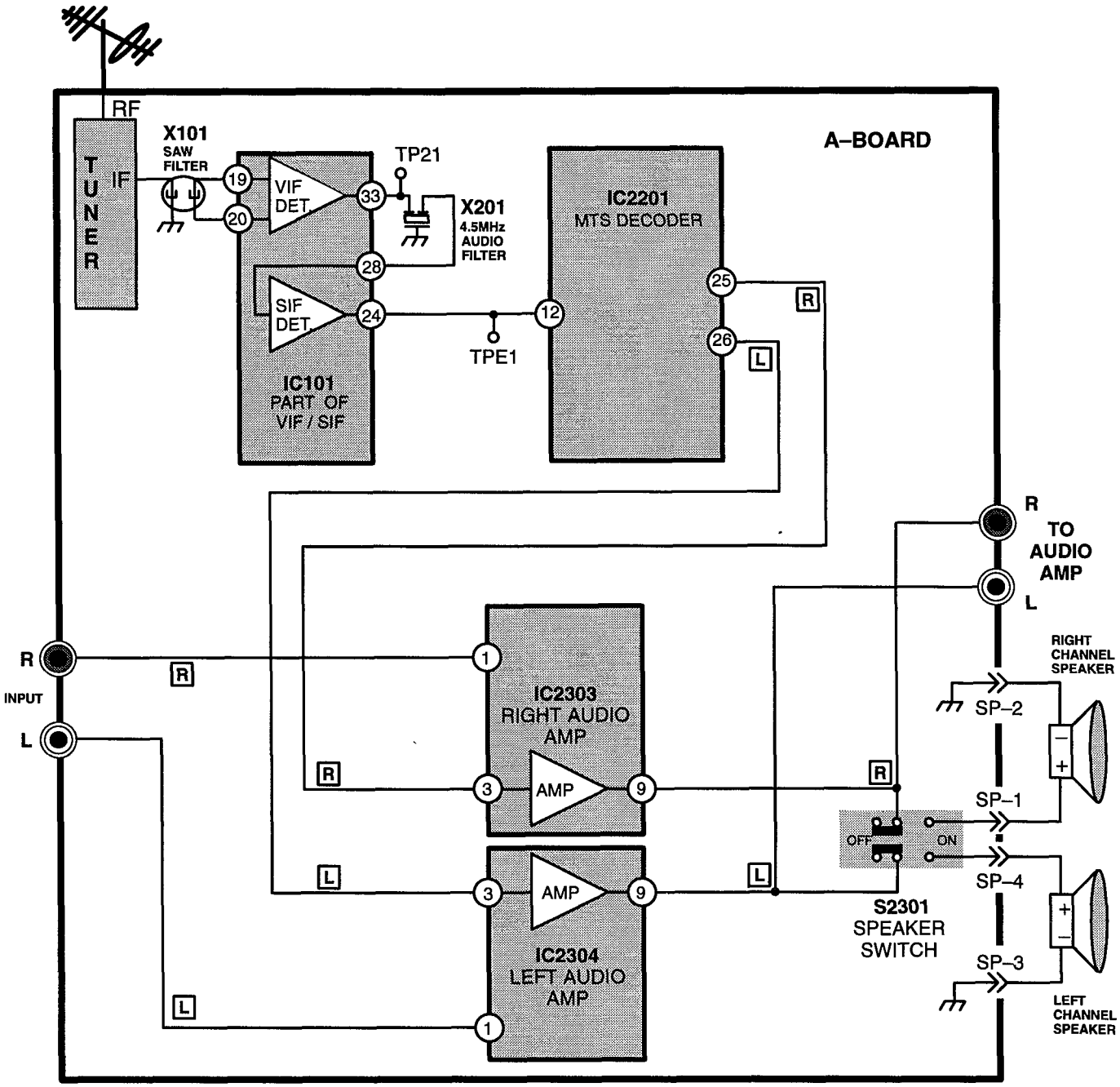


Figure 26. **Audio Signal Path Block Diagram**

Video–Chroma Signal Path Block Diagram

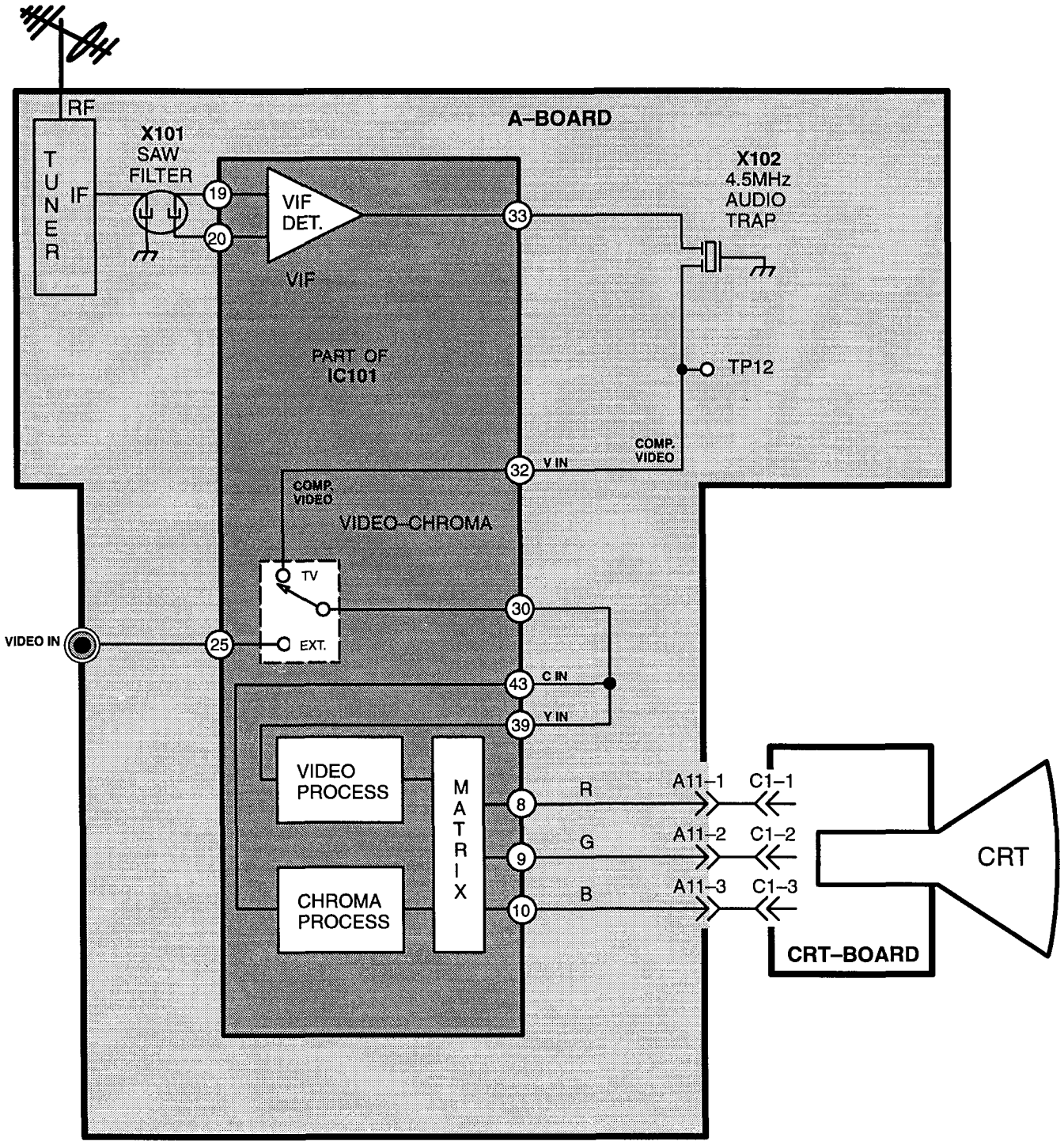
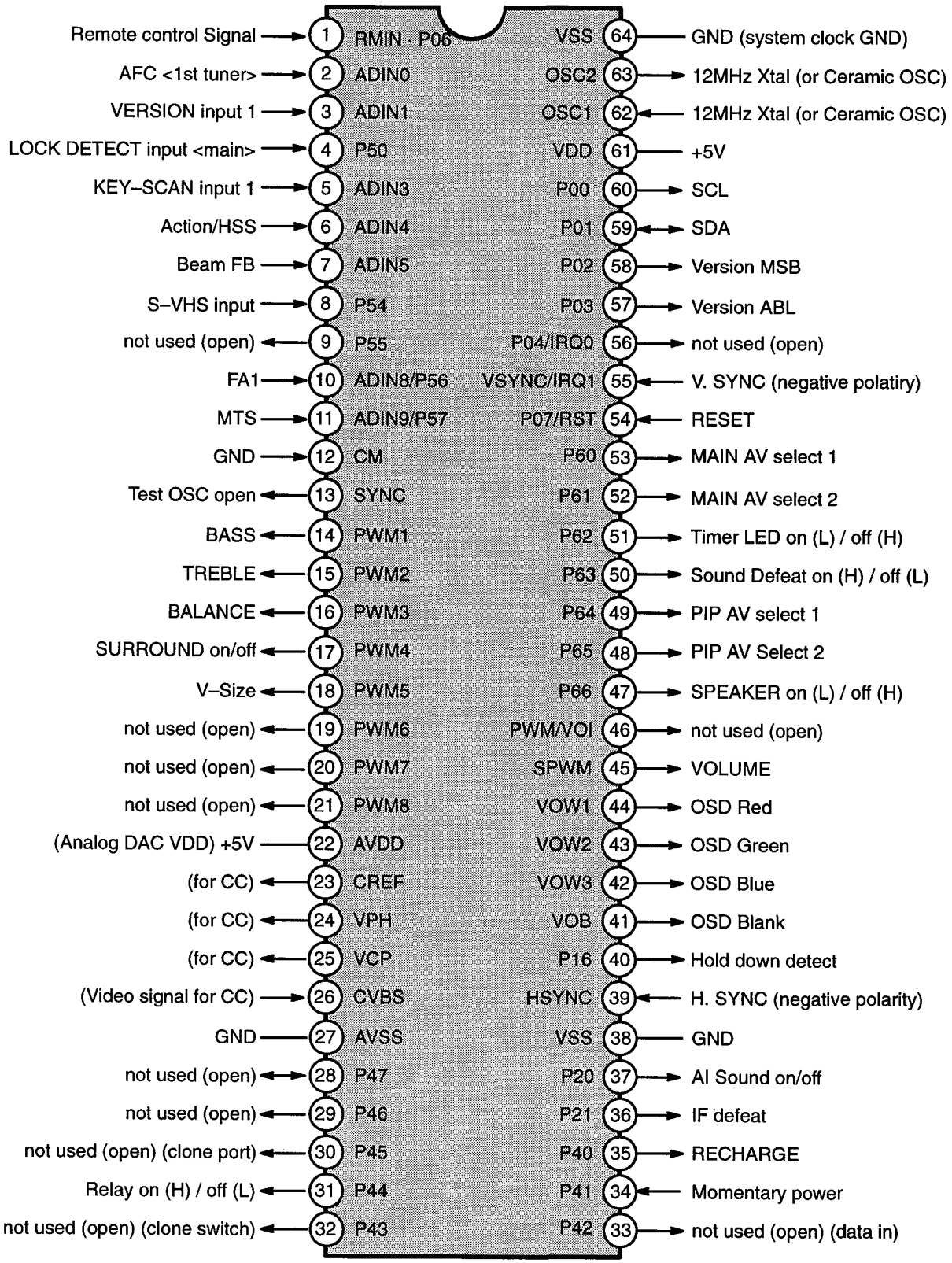


Figure 27. **Video–Chroma Signal Path Block Diagram**

IC001 MPU IN/OUT Pins and Functions
MN1873265T7P



IC101 Block Diagram

INPUT PINS = ◁ ▷ OUTPUT PINS = ◀ ▶

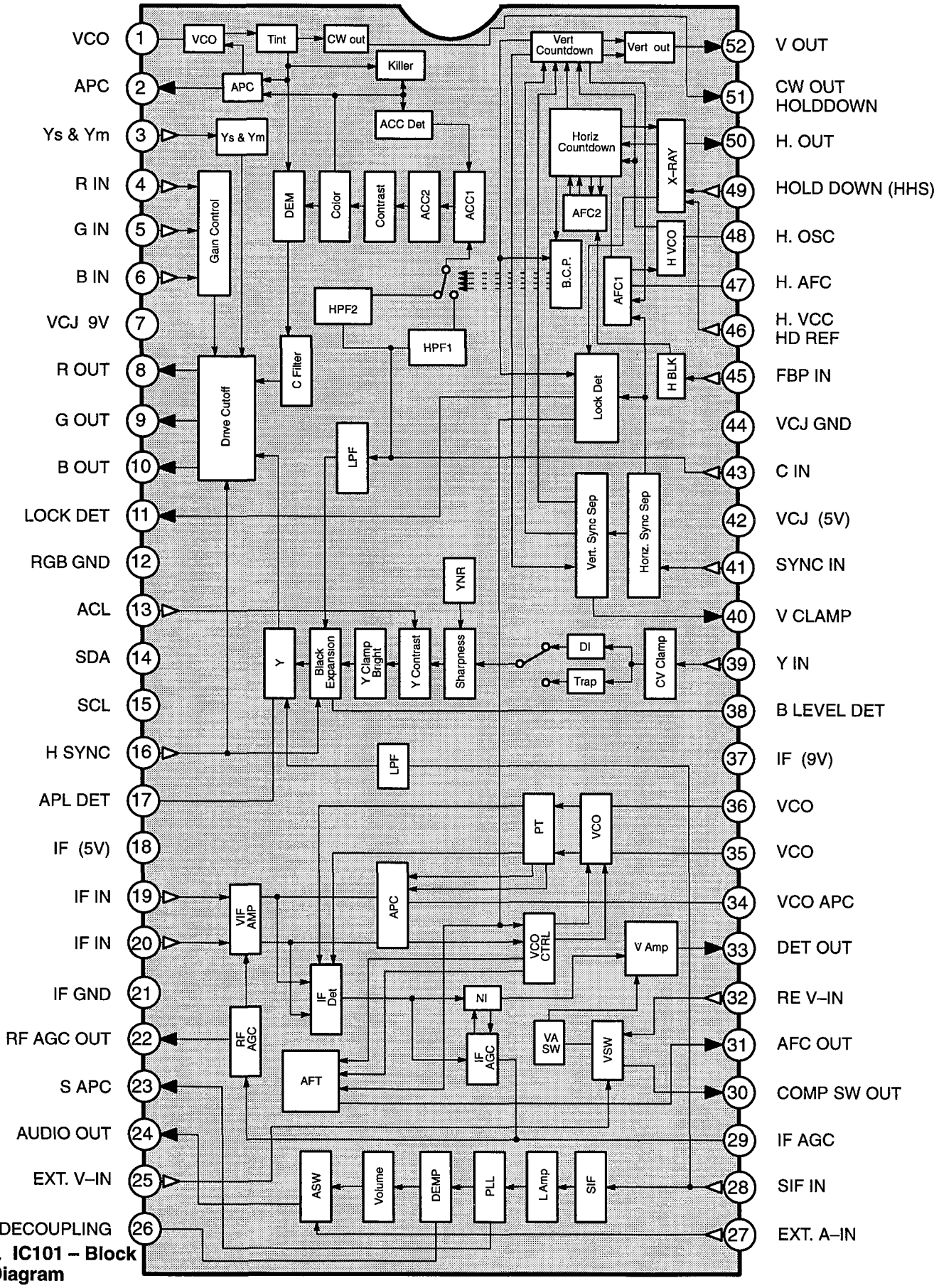


Figure 28. **IC101 – Block Diagram**

REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
		CAPRISTORS
CRA801	**EXNG471P365**	**RES-CAP 470PF/3.6 MEG**
CRA802	**EXNG471P365**	**RES-CAP 470PF/3.6 MEG**
		CAPACITORS
C001	ECA1AM101	CAP,E 100UF/10V
C003	ECA1HM4R7	CAP,E 4.7UF/50V
C004	ECUX1H330JCX	CAP,C 33PF-J-50V
C005	ECUX1H330JCX	CAP,C 33PF-J-50V
C008	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C010	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C011	ECA1CM221	CAP,E 220UF/16V
C013	ECA0JM101	CAP,E 100UF/6.3V
C016	ECUX1H101JCX	CAP,C 100PF-J-50V
C017	ECUX1H220JCX	CAP,C 22PF-J-50V
C018	ECUX1H220JCX	CAP,C 22PF-J-50V
C019	ECA0JM101	CAP,E 100UF/6.3V
C020	ECA0JM101	CAP,E 100UF/6.3V
C022	ECA1CM471	CAP,E 470UF/16V
C024	ECA1EM4R7	CAP,E 4.7UF/25V
C025	ECUX1H101JCX	CAP,C 100PF-J-50V
C026	ECA1HM010	CAP,E 1.0UF/50V
C031	ECUX1H821KBX	CAP,C 820PF-K-50V
C032	ECA1AM470	CAP,E 47UF/10V
C033	ECUX1H101JCX	CAP,C 100PF-J-50V
C036	ECUX1H220JCX	CAP,C 22PF-J-50V
C037	ECUX1H220JCX	CAP,C 22PF-J-50V
C038	ECUX1H220JCX	CAP,C 22PF-J-50V
C101	ECUX1H223ZFX	CAP,C .022UF-Z-50V
C102	ECA1EM100	CAP,E 10UF/25V
C103	ECUX1H300JCX	CAP,C 30PF-J-50V
C105	ECUX1H221JCX	CAP,C 220PF-J-50V
C106	ECA1HMR47	CAP,E .47UF/50V
C107	ECUX1H560JCX	CAP,C 56PF-J-50V
C108	ECA1HMR22	CAP,E .22UF/50V
C109	ECEA1HN4R7U	CAP,E 4.7UF/50V
C110	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C111	ECA1EM100	CAP,E 10UF/25V
C113	ECA1EM100	CAP,E 10UF/25V
C117	ERJ6GEYJ333	RES,M 33K-J-1/10
C151	ECA1HMR22	CAP,E .22UF/50V
C201	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C202	ECUX1H101JCX	CAP,C 100PF-J-50V
C203	ECA1EM4R7	CAP,E 4.7UF/25V
C301	ECUX1H390JCX	CAP,C 39PF-J-50V
C302	ECEA1HN010U	CAP,E 1UF/50V
C304	ECEA1HNR47U	CAP,E .47UF-50V
C305	ECA1EM4R7	CAP,E 4.7UF/25V
C306	ECA1CM221	CAP,E 220UF/16V
C308	ECQB1H823KF	CAP,P .082UF-K-50V
C309	ECA1AM101	CAP,E 100UF/10V
C310	ECA1EM4R7	CAP,E 4.7UF/25V
C311	ECA1EM4R7	CAP,E 4.7UF/25V
C312	ECA1EM220	CAP,E 22UF/25V
C314	ECUX1H104ZFX	CAP,C .1UF-Z-50V
C351	TACCW391T50V	CAP,C 390PF/50V
C352	TACCW391T50V	CAP,C 390PF/50V
C353	TACCW471T50V	CAP,C 470PF/50V
C354	ECKD3D102KB	CAP,C .001UF-K-2KV
C357	ECEA1HN010U	CAP,E 1UF/50V
C401	ECQB1H153KF	CAP,P .015UF-K-50V
C402	ECUX1H471KBX	CAP,C 470PF-K-50V
C403	ECA1HM2R2	CAP,E 2.2UF/50V
C451	ECA1AM470	CAP,E 47UF/10V
C452	ECSF1EE105	CAP,T 1.0UF/25V
C453	ECEA1HFS2R2	CAP,E 2.2UF/50V
C454	ECA1EM102	CAP,E 1000UF/25V
C455	ECEA1EGE101	CAP,E 100UF/25V
C456	ECQB1H103JF	CAP,P .01UF-J-50V
C459	ECA1VM471	CAP,E 470UF/35V
C462	ECA1EM100	CAP,E 10UF/25V
C502	ECQB1H223JF	CAP,P .022UF-J-50V
C503	ECA1HM2R2	CAP,E 2.2UF/50V
C504	ECUX1H101JCX	CAP,C 100PF-J-50V
C505	ECUX1H221JUX	CAP,C 220PF-J-50V
C506	ECA1CM221	CAP,E 220UF/16V
C507	ECUX1H221JCX	CAP,C 220PF-J-50V
C508	ECUX1H121JCX	CAP,C 120PF-J-50V
C510	ECCD2H100D	CAP,C 10PF-D-500V
C511	ECKD2H821KB	CAP,C 820PF-K-500V
C512	ECKD2H101KB	CAP,C 100PF-K-500V
C531	**ECA1EM220**	**CAP,E 22UF/25V**
C532	ECA1AM102	CAP,E 1000UF/10V
C534	TCUX1H103ZFN	CAP,C .01UF-Z-50V
C551	**ECA1VM331**	**CAP,E 330UF/35V**
C552	**ECA1EM471**	**CAP,E 470UF/25V**
C553	ECKD2H561KB	CAP,C 560PF-K-500V
C554	ECKD2H561KB	CAP,C 560PF-K-500V
C555	**ECEA2EU220**	**CAP,E 22UF/250V**
C556	**ECA1CM471**	**CAP,E 470UF/16V**
C557	ECKD2H222KB	CAP,C 0022UF-K-500V
C559	ECA1HM220	CAP,E 22UF/50V
C560	**ECEA1HN2R2U**	**CAP,E 2.2UF/50V**
C561	ECKD2H561KB	CAP,C 560PF-K-500V
C564	**ECWH12H822JS**	**CAP,P .0082UF-J-1.2KV**
C565	**ECKD3D102JB**	**CAP,C .001UF-J-2KV**
C566	**ECKD3D181JB**	**CAP,C 180PF-J-2KV**
C569	**ECWF2394JBB**	**CAP,P .39UF-J-200V**
C571	ECA1EM220	CAP,E 22UF/25V
C572	ECA1EM100	CAP,E 10UF/25V
C573	ECA1CM101	CAP,E 100UF/16V
C601	ECUX1H181JCX	CAP,C 180PF-J-50V
C602	ECUX1H680JCX	CAP,C 68PF-J-50V
C604	ECUX1H150JUX	CAP,C 15PF-J-50V
C605	ECUX1H332KBX	CAP,C .0033UF-K-50V
C606	ECA1HM010	CAP,E 1.0UF/50V
C801	**ECKD2H472PU**	**CAP,C .0047UF-P-500V**
C802	**ECKD2H472PU**	**CAP,C .0047UF-P-500V**
C805	**EC0S2DG151DG**	**CAP,E 151UF/200V**
		20CX20B501 ***20CX20B511***
C805	**EC0S2EG151B4**	**CAP,E 150UF-250V**
		20CX20B521

PARTS LIST

REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
C806	**EC0S2DG151DG**	**CAP,E 151UF/200V**
		20CX20B501 20CX20B511
C806	**EC0S2EG151B4**	**CAP,E 150UF–250V**
		20CX20B521
C807	ECA1HM3R3	CAP,E 3.3UF/50V
C808	ECA1CM101	CAP,E 100UF/16V
C809	**EC0S2DG151DG**	**CAP,E 151UF/200V**
C810	**ECQU2A153MN**	**CAP,P .015UF–M–250VAC**
		20CX20B501 20CX20B511
C810	**ECQU2A682MN**	**CAP,P 6800UF–M–250VAC**
		20CX20B521
C811	**ECQU2A153MN**	**CAP,P .015UF–M–250VAC**
		20CX20B501 20CX20B511
C811	**ECQU2A682MN**	**CAP,P 6800UF–M–250VAC**
		20CX20B521
C812	**ECQU2A224MV**	**CAP,P .22F–M–250V**
C814	ECQB1H333JF	CAP,P .033UF–J–50V
C815	ECEA1HGE470	CAP,E 47UF/50V
C818	ECKD3A821KB	CAP,C 820PF–K–1KVDC
C820	**ECEA1JGE100**	**CAP,E 10UF/63V**
C823	**ECEA160V33Z**	**CAP,E 33UF/160V**
C824	ECKD3A331KB	CAP,C 330PF–K–1KVDC
C825	ECKD3A471KB	CAP,C 470PF–K–1KV
C2201	AP335K016CAE	CAP,T 3.3UF/16V
C2202	ECA1EM4R7	CAP,E 4.7UF/25V
C2203	ECA1HM010	CAP,E 1.0UF/50V
C2204	ECA1EM4R7	CAP,E 4.7UF/25V
C2205	ECA1EM4R7	CAP,E 4.7UF/25V
C2206	ECA1EM4R7	CAP,E 4.7UF/25V
C2207	ECA1EM4R7	CAP,E 4.7UF/25V
C2208	ECA1EM4R7	CAP,E 4.7UF/25V
C2209	ECA1AM101	CAP,E 100UF/10V
C2210	ECA1HMR33	CAP,E .33UF/50V
C2211	ECEA1HUR68	CAP,E .68UF/50V
C2212	ECA1HM2R2	CAP,E 2.2UF/50V
C2213	ECA1EM100	CAP,E 10UF/25V
C2214	ECQB1H104JF	CAP,P .1UF–J–50V
C2215	ECQB1H223JF	CAP,P .022UF–J–50V
C2216	ECUX1H332KBX	CAP,C .0033UF–K–50V
C2217	ECEA1HN010U	CAP,E 1UF/50V
C2218	ECEA1HN010U	CAP,E 1UF/50V
C2219	AP106K016CAE	CAP,T 10UF/16V
C2220	ECEA1CN100U	CAP,E 10UF–16V
C2221	TCUX1H103KBN	CAP,C .01UF–K–50V
C2222	ECUX1H472KBX	CAP,C .0047UF–K–50V
C2302	ECEA1HGE3R3	CAP,E 3.3UF/50V
C2303	ECEA1EGE100	CAP,E 10UF/25V
C2304	ECQB1H104JF	CAP,P .1UF–J–50V
C2306	ECA1CM221	CAP,E 220UF/16V
C2307	ECEA1HN010U	CAP,E 1UF/50V
C2309	ECEA1HGE010	CAP,E 1UF/50V
C2310	ECUX1H332KBX	CAP,C .0033UF–K–50V
C2311	ECA1HM3R3	CAP,E 3.3UF/50V
C2351	ECA1EM102	CAP,E 1000UF/25V
C2352	ECEA1HGE3R3	CAP,E 3.3UF/50V
C2353	ECEA1EGE100	CAP,E 10UF/25V
C2354	ECQB1H104JF	CAP,P .1UF–J–50V
C2356	ECA1CM221	CAP,E 220UF/16V
C2357	ECEA1HN010U	CAP,E 1UF/50V
C2358	ECUX1H332KBX	CAP,C .0033UF–K–50V
C3001	ECA1HM010	CAP,E 1.0UF/50V
C3002	ECA1HM010	CAP,E 1.0UF/50V
C3003	ECA1HM010	CAP,E 1.0UF/50V
C3005	ECUX1H272KBX	CAP,C .0027UF–K–50V
C3006	ECUX1H272KBX	CAP,C .0027UF–K–50V
		DIODES
D001	ERA15–01	DIODE
D002	MA165	DIODE
D003	MA4047M	DIODE, ZENER
D006	MA4330H	DIODE
D008	MA165	DIODE
D009	MA165	DIODE
D011	MA165	DIODE
D016	MA165	DIODE
D017	MA165	DIODE
D451	ERA15–01	DIODE
D452	MA4047M	DIODE, ZENER
D501	MA4082L	DIODE
D531	**AS01**	**DIODE**
D532	**MA4062L**	**DIODE**
D551	**TVSRU2N**	**DIODE**
D553	**BYD33G–143**	**DIODE**
D554	**BYD33G–143**	**DIODE**
D555	MA165	DIODE
D556	MA4360H	DIODE, ZENER
D560	MA165	DIODE
D561	**BYD33G–143**	**DIODE**
D801	**EM02BM**	**DIODE**
D802	**EM02BM**	**DIODE**
D806	MA4047H	DIODE
D807	MA165	DIODE
D810	**TAP104XM05**	**PTC**
D820	EU02V1	DIODE
D821	EU02V1	DIODE
D822	EU02V1	DIODE
D823	RL30A	DIODE
D824	EU02V1	DIODE
D825	**TVSSR2KL**	**DIODE, PROTECTION**
D826	EU02V1	DIODE
D829	MA165	DIODE
D2301	MA165	DIODE
D2302	MA165	DIODE
D2312	MA4068M	DIODE, ZENER
D3001	MA165	DIODE
D3002	MA4110M	DIODE, ZENER
D3004	MA4110M	DIODE, ZENER
D3005	MA4110M	DIODE, ZENER
D3006	MA4110M	DIODE, ZENER
D3007	MA4110M	DIODE, ZENER
D3008	MA4110M	DIODE, ZENER
D3009	MA4110M	DIODE, ZENER
D3010	MA4110M	DIODE, ZENER

REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
D3011	MA4110M	DIODE, ZENER
		FUSES
F801	**XBA2C63TR0**	**FUSE, 250V–6.3A**
		20CX20B521
F801	**0BA1C63NU100**	**FUSE (6.3A–125V)**
		20CX20B501 20CX20B511
		INTEGRATED CIRCUITS
IC001	MN1873265T7P	INT CKT
IC002	24LC02BIP	INT CKT
IC003	PIC–12042SRB	RECEIVER, REMOTE CONTROL
IC101	**AN5165K**	**INT CKT**
IC451	**LA7837–TV**	**INT CKT**
IC551	**AN78M09**	**PLUS 9V AVR**
IC552	AN78M05	PLUS 5V AVR
IC801	**0N3131R**	**INT CKT**
IC803	**STR58041A**	**INT CKT**
IC2201	AN5819K	INT CKT
IC2303	LA4285	INT CKT
IC2304	LA4285	INT CKT
		COILS
DEG	**0LK19042A**	**COIL, DEGAUSSING 20"**
DY	**0LY15312F1**	**YOKE, DEFLECTION**
L001	TSKA074	FERRITE BEAD
L002	TLTACT390K	COIL, PEAKING 39UH
L003	TLUABTA2R2K	COIL, PEAKING 2.2UH
L004	TLUABTA2R2K	COIL, PEAKING 2.2UH
L006	TSKA072	FERRITE BEAD
L008	TLUABTA470K	COIL, PEAKING 47UH
L009	TSKA074	FERRITE BEAD
L103	TLUABTA150K	COIL, PEAKING 15UH
L104	TLUABTA1R0K	COIL, PEAKING 1.0UH
L105	EIV7EN053B	COIL, VCO
L106	TLTACT180J	COIL, PEAKING 18UH
L551	**TLH15652P**	**COIL, LINEARITY**
L602	TLTACT120J	COIL, PEAKING 12UH
L801	**ELF15N013A**	**LINE FILTER**
		20CX20B511 20CX20B521
L801	**ELF20N020A**	**COIL, 2UH**
		20CX20B501
L802	ELEIE680KA	COIL, PEAKING 68UH
L804	TSKA076	FERRITE BEAD
L2201	ELESN102JA	COIL, PEAKING 1000UH
L2202	ELESN471JA	COIL, PEAKING 470UH
L2301	TSKA064	FERRITE BEAD
		TRANSISTORS
Q001	MSD601–RT1	TRANSISTOR
Q002	JC501PQ	TRANSISTOR
Q003	MSB709–RT1	TRANSISTOR
Q004	MSB709–RT1	TRANSISTOR
Q005	MSD601–RT1	TRANSISTOR
Q302	MSD601–RT1	TRANSISTOR
Q304	MSD601–RT1	TRANSISTOR
Q351	2SC3063	TRANSISTOR
Q352	2SC3063	TRANSISTOR
Q353	2SC3063	TRANSISTOR
Q451	MSD601–RT1	TRANSISTOR

REF. NO.	PART NO.	DESCRIPTION
Q452	MSD601–RT1	TRANSISTOR
Q501	2SC1573AH	TRANSISTOR
Q551	**BU2506DF**	**TRANSISTOR**
Q801	2SC1685RS	TRANSISTOR
Q802	2SC1685RS	TRANSISTOR
Q804	2SA1767Q	TRANSISTOR
Q2309	MSB709–RT1	TRANSISTOR
Q3001	MSD601–RT1	TRANSISTOR
		RELAYS
RL801	**TSEH8007**	**RELAY**
		RESISTORS
C117	ERJ6GEYJ333	RES,M 33K–J–1/10
R002	ERJ6GEYJ182	RES,M 1.8K–J–1/10
R003	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R004	ERDS1TJ181	RES,C 180–J–1/2
R005	ERDS2TJ101	RES,C 100–J–1/4
R006	ERJ6GEYJ391	RES,M 390–J–1/10
R007	ERJ6GEYJ561	RES,M 560–J–1/10
R008	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R010	ERJ6GEYJ154	RES,M 150K–J–1/10
R011	ERJ6GEYJ684	RES,M 680K–J–1/10
R012	ERJ6GEYJ473	RES,M 47K–J–1/10
R016	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R017	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R020	ERJ6GEYJ474	RES,M 470K–J–1/10
R021	ERJ6GEYJ101	RES,M 100–J–1/10
R022	ERJ6GEYJ101	RES,M 100–J–1/10
R023	ERJ6GEYJ102	RES,M 1K–J–1/10
R025	ERJ6GEYJ103	RES,M 10K–J–1/10
R027	ERJ6GEYJ103	RES,M 10K–J–1/10
R028	ERJ6GEYJ103	RES,M 10K–J–1/10
R030	ERJ6GEYJ102	RES,M 1K–J–1/10
R032	ER0S2CKF1002	RES,M 10K–F–1/4
R033	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R034	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R035	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R036	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R037	ERJ6GEYJ103	RES,M 10K–J–1/10
R038	ERJ6GEYJ223	RES,M 22K–J–1/10
R039	ERDS2TJ102	RES,C 1K–J–1/4
R046	ERDS2TJ223	RES,C 22K–J–1/4
R047	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R048	ERJ6GEYJ221	RES,M 220–J–1/10
R049	ERJ6GEYJ221	RES,M 220–J–1/10
R053	ERJ6GEYJ103	RES,M 10K–J–1/10
R055	ERJ6GEYJ103	RES,M 10K–J–1/10
R060	ERJ6GEYJ102	RES,M 1K–J–1/10
R065	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R066	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R067	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R068	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R070	ERJ6GEYJ101	RES,M 100–J–1/10
R101	ERJ6GEYJ750	RES,M 75–J–1/10
R102	ERJ6GEYJ683	RES,M 68K–J–1/10
R103	ERJ6GEYJ183	RES,M 18K–J–1/10
R104	ERJ6GEYJ681	RES,M 680–J–1/10

REPLACEMENT PARTS LIST

(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
R105	ERJ6GEYJ681	RES,M 680–J–1/10
R106	ERJ6GEYJ122	RES,M 1.2K–J–1/10
R107	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R108	ERJ6GEYJ471	RES,M 470–J–1/10
R152	ERDS2TJ183	RES,C 18K–J–1/4
R153	ERJ6GEYJ223	RES,M 22K–J–1/10
R154	ERJ6GEYJ393	RES,M 39K–J–1/10
R201	ERJ6GEYJ471	RES,M 470–J–1/10
R202	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R203	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R303	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R304	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R305	ER0S2CKF3001	RES,M 3K–F–1/4
R306	ERJ6ENF1651	RES,M 1.65K–F–1/10
R307	ERJ6GEYJ564	RES,M 560K–J–1/10
R308	ERJ6GEYJ102	RES,M 1K–J–1/10
R309	ERJ6GEYJ333	RES,M 33K–J–1/10
R310	ERJ6GEYJ223	RES,M 22K–J–1/10
R311	ERJ6GEYJ185	RES,M 1.8MEG–J–1/10W
R317	ERJ6GEYJ684	RES,M 680K–J–1/10
R319	ERJ6GEYJ122	RES,M 1.2K–J–1/10
R320	ERJ6GEYJ102	RES,M 1K–J–1/10
R351	ERG2FJ123H	RES,M 12K–J–2W
R352	ERG2FJ123H	RES,M 12K–J–2W
R353	ERG2FJ123H	RES,M 12K–J–2W
R354	ERDS1TJ272	RES,C 2.7K–J–1/2
R355	ERDS1TJ272	RES,C 2.7K–J–1/2
R356	ERDS1TJ272	RES,C 2.7K–J–1/2
R357	ERDS2TJ301	RES,C 300–J–1/4
R358	ERDS2TJ301	RES,C 300–J–1/4
R359	ERDS2TJ301	RES,C 300–J–1/4
R360	ERDS2TJ102	RES,C 1K–J–1/4
R361	ERDS2TJ102	RES,C 1K–J–1/4
R362	ERDS2TJ102	RES,C 1K–J–1/4
R363	ERDS2TJ101	RES,C 100–J–1/4
R364	ERDS2TJ101	RES,C 100–J–1/4
R365	ERDS2TJ101	RES,C 100–J–1/4
R401	ERJ6GEYJ102	RES,M 1K–J–1/10
R451	ERDS1FJ1R2	RES,C 1.2–J–1/2
R454	ERJ6GEYJ473	RES,M 47K–J–1/10
R455	ERJ6GEYJ153	RES,M 15K–J–1/10
R456	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R457	ERJ6GEYJ911	RES,M 910–J–1/10
R458	ERJ6GEYJ273	RES,M 27K–J–1/10
R459	ERJ6GEYJ683	RES,M 68K–J–1/10
R460	ERDS2TJ102	RES,C 1K–J–1/4
R462	ERJ6GEYJ473	RES,M 47K–J–1/10
R463	ERJ6GEYJ473	RES,M 47K–J–1/10
R465	ERJ6GEYJ103	RES,M 10K–J–1/10
R466	ERJ6GEYJ103	RES,M 10K–J–1/10
R467	ERJ6GEYJ104	RES,M 100K–J–1/10
R468	ERJ6GEYJ101	RES,M 100–J–1/10
R469	ERJ6GEYJ220	RES,M 22–J–1/10
R470	ERDS2TJ152	RES,C 1.5K–J–1/4
R471	ERJ6GEYJ223	RES,M 22K–J–1/10
R501	ERJ6GEYJ102	RES,M 1K–J–1/10
R502	ERDS2TJ562	RES,C 5.6K–J–1/4
R503	ERJ6GEYJ822	RES,M 8.2K–J–1/10
R504	ERJ6GEYJ821	RES,M 820–J–1/10
R505	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R506	ERJ6GEYJ182	RES,M 1.8K–J–1/10
R507	ERJ6GEYJ392	RES,M 3.9K–J–1/10
R508	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R509	ERDS2TJ331	RES,C 330–J–1/4
R510	**ERG3FJ182H**	**RES,M 1.8K–J–3W**
R512	ERG2FJ562H	RES,M 5.6K–J–2W
R531	**ERD25FJ470**	**RES,C 47–J–1/4**
R532	**ERJ6ENF4422**	**RES,M 44.2K–F–1/10**
R533	**ERJ6ENF1502**	**RES,M 15K–F–1/10W**
R536	ERJ6GEYJ223	RES,M 22K–J–1/10
R537	ERJ6GEYJ473	RES,M 47K–J–1/10
R551	**ERDS1FJ1R0**	**RES,C 1.0–J–1/2**
R552	**ERDS1FJ1R0**	**RES,C 1.0–J–1/2**
R553	**ERDS1FJ1R0**	**RES,C 1.0–J–1/2**
R554	ERG2FJ390H	RES,M 39–J–2W
R555	ERDS1FJ101	RES,C 100–J–1/2
R556	ERDS2TJ332	RES,C 3.3K–J–1/4
R557	ERDS2TJ103	RES,C 10K–J–1/4
R558	**ERQ2CJP1R3**	**RES,F 1.3–J–2W**
R559	ERG2FJ683H	RES,M 12K–J–2W
R560	ERDS1FJ182	RES,C 1.8K–J–1/2
R563	ERDS2TJ124	RES,C 120K–J–1/4
R564	ERDS2TJ104	RES,C 100K–J–1/4
R565	ERDS2TJ103	RES,C 10K–J–1/4
R567	ERG2FJ122H	RES,M 12K–J–2W
R602	ERJ6GEYJ331	RES,M 330–J–1/10
R603	ERJ6GEYJ331	RES,M 330–J–1/10
R604	ERJ6GEYJ331	RES,M 330–J–1/10
R614	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R801	**ERF7ZK1R5**	**RES,W 1.5–K–7W**
R805	ERDS2TJ274	RES,C 270K–J–1/4
R806	ERDS2TJ274	RES,C 270K–J–1/4
R808	ERDS1FJ1R5	RES,C 1.5–J–1/2
R809	ERDS1FJ1R5	RES,C 1.5–J–1/2
R810	ERDS1FJ272	RES,C 2 7K–J–1/2
R812	ERDS1TJ183	RES,C 18K–J–1/2
R813	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R815	**ERC12ZGM825**	**RES,S 8.2MEG–M–1/2**
R817	**ERX3FJ4R7**	**RES,M 4.7–J–3W**
R820	ERJ6GEYJ153	RES,M 15K–J–1/10
R821	ERJ6GEYJ392	RES,M 3.9K–J–1/10
R822	ERD50FJ474	RES,C 470K–J–1/2W
R823	ERDS2TJ222	RES,C 2.2K–J–1/4
R824	ERG3FJ680H	RES,M 68–J–3W
R825	ERDS2TJ102	RES,C 1K–J–1/4
R826	ERF2AKR33	RES,W .33–K–2W
R827	ERDS1FJ561	RES,C 560–J–1/2
R828	ERG3FJ470H	RES,M 47–J–3W
R829	ERQ14AJ270	RES,F 27–J–1/4
R2201	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R2202	ERJ6GEYJ153	RES,M 15K–J–1/10
R2203	ERJ6GEYJ104	RES,M 100K–J–1/10

REPLACEMENT PARTS LIST

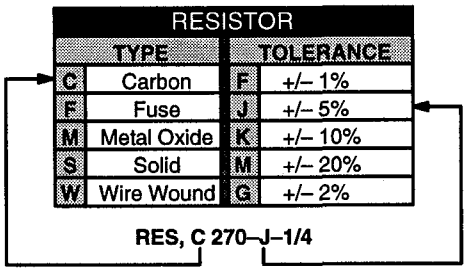
(Models: 20CX20B501, 20CX20B511 & 20CX20B521)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
R2204	ERJ6GEYJ473	RES,M 47K–J–1/10
R2205	ERJ6GEYJ154	RES,M 150K–J–1/10
R2206	ERJ6GEYJ102	RES,M 1K–J–1/10
R2207	ERJ6GEYJ102	RES,M 1K–J–1/10
R2208	ERJ6ENF9102	RES,M 91K–F–1/10
R2212	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R2301	ERQ2CJP120	RES,F 12–J–2W
R2303	ERD25FJ1R0	RES,C 1.0–J–1/4
R2306	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R2310	ERDS2TJ221	RES,C 220–J–1/4
R2311	ERJ6GEYJ103	RES,M 10K–J–1/10
R2312	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R2313	ERJ6GEYJ683	RES,M 68K–J–1/10
R2314	ERJ6GEYJ104	RES,M 100K–J–1/10
R2317	ERJ6GEYJ561	RES,M 560–J–1/10
R2318	ERJ6GEYJ103	RES,M 10K–J–1/10
R2319	ERDS2TJ392	RES,C 3.9K–J–1/4
R2321	ERDS2TJ101	RES,C 100–J–1/4
R2322	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R2353	ERD25FJ1R0	RES,C 1.0–J–1/4
R2356	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R2357	ERJ6GEYJ103	RES,M 10K–J–1/10
R2358	ERJ6GEYJ122	RES,M 1.2K–J–1/10
R2359	ERJ6GEYJ103	RES,M 10K–J–1/10
R2360	ERJ6GEYJ122	RES,M 1.2K–J–1/10
R2361	ERJ6GEYJ681	RES,M 680–J–1/10
R2362	ERJ6GEYJ681	RES,M 680–J–1/10
R3001	ERJ6GEYJ473	RES,M 47K–J–1/10
R3002	ERJ6GEYJ104	RES,M 100K–J–1/10
R3005	ERDS2TJ750	RES,C 75–J–1/4
R3006	ERDS2TJ390	RES,C 39–J–1/4
R3009	ERDS2TJ682	RES,C 6.8K–J–1/4
R3010	ERJ6GEYJ334	RES,M 330K–J–1/10
R3011	ERDS2TJ682	RES,C 6.8K–J–1/4
R3012	ERDS2TJ334	RES,C 330K–J–1/4
R3013	ERDS2TJ682	RES,C 6.8K–J–1/4
R3014	ERDS2TJ682	RES,C 6.8K–J–1/4
		SWITCHES
S001	EVQQBH12T	SWITCH, PUSH
S002	EVQQBH12T	SWITCH, PUSH
S003	EVQQBH12T	SWITCH, PUSH
S004	EVQQBH12T	SWITCH, PUSH
S005	EVQQBH12T	SWITCH, PUSH
S006	EVQQBH12T	SWITCH, PUSH
S007	EVQQBH12T	SWITCH, PUSH
S2301	ESB621283	SWITCH, CATV

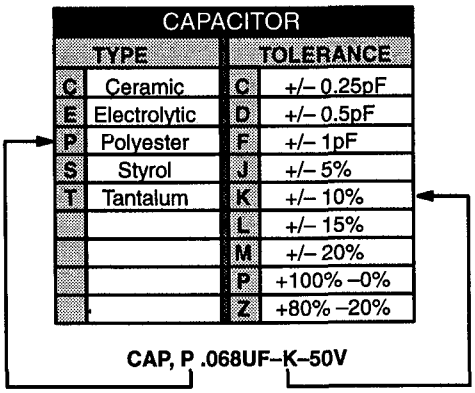
REF. NO.	PART NO.	DESCRIPTION
		TRANSFORMERS
T001	**TLP16297**	**TRANSFORMER, POWER SUPPLY**
T501	**ETH19Y70AYM**	**TRANSFORMER, HORIZONTAL DRIVER**
T502	**ETE19Z30AY**	**TRANSFORMER, HORIZONTAL COUPLING**
T551	**KFT3AB054F**	**TRANSFORMER, FLYBACK**
T801	**ETS25AD129NC**	**TRANSFORMER**
		CRYSTALS/FILTERS
X001	TSS2080MX	CRYSTAL, 12 MHZ CLOCK
X101	M1969M	SAW FILTER
X102	EFCWS4504AB	FILTER 4.5MHZ
X201	EFCS4R5MS5W	FILTER 4.5MHZ BANDPASS
X501	TAFCSB503F38	CRYSTAL, CLOCK
X601	TSS2AA001	CRYSTAL, 3.58MHZ
		OTHERS
M001	**A51KQN011X**	**CRT 20"**
M002	EASG9D550B2	SPEAKER
TNR001	**ENV56D18G3**	**TUNER**
M003	HL00761	TRANSMITTER, REMOTE CONTROL
M004	TBX1886601	PUSHBUTTON, SPEAKER
M005	TBX2A50211G	ASSY. 7 PUSHBUTTON
JK351	**TJSC00300**	**CRT SOCKET**
M006	TMM2A30702	WEDGE, YOKE
M007	TPC2AA03901	PKG., RSC
M008	TPD2A30261–1	PKG., TOP PAD
M009	TPD2A30262	PKG., BOTTOM PAD
M010	TQB2AA0180	MANUAL, OWNERS *20CX20B511*
M011	TQB2AA0181	MANUAL, OWNERS (BI–LING) *20CX20B501*
M012	TQB2AA0182	MANUAL, OWNERS (SPANISH) *20CX20B521*
M013	**TSX2AA0011**	**LINE CORD**
M014	TXFKU2497SER	ASSY. CABINET BACK 20" *20CX20B501*
M015	TXFKU2597SER	ASSY. CABINET BACK 20" *20CX20B511*
M016	TXFKU2697SER	ASSY. CABINET BACK 20" *20CX20B521*
M017	TXFKY2797SER	ASSY. CABINET FRONT 20" *20CX20B501 20CX20B511*
M018	TXFKY2897SER	ASSY. CABINET FRONT 20" *20CX20B521*
M019	TXF3A011DB2	ASSY. DAG GROUND
M020	0FMK014ZZ	CONVERGENCE CORRECTOR STRIP
JK3001	TJB2A9063B	ASSY. JACK 1A/V

DESCRIPTION OF ABBREVIATIONS GUIDE



RESISTOR			
TYPE		TOLERANCE	
C	Carbon	F	+/– 1%
F	Fuse	J	+/– 5%
M	Metal Oxide	K	+/– 10%
S	Solid	M	+/– 20%
W	Wire Wound	G	+/– 2%

RES, C 270–J–1/4



CAPACITOR			
TYPE		TOLERANCE	
C	Ceramic	C	+/– 0.25pF
E	Electrolytic	D	+/– 0.5pF
P	Polyester	F	+/– 1pF
S	Styrol	J	+/– 5%
T	Tantalum	K	+/– 10%
		L	+/– 15%
		M	+/– 20%
		P	+100% –0%
		Z	+80% –20%

CAP, P .068UF–K–50V

SERVICEMAN MODE (ELECTRONIC CONTROL)
SERVICE ADJUSTMENT VALUES

Model _____ Ser # _____ Date _____

Note: Record the original settings PRIOR to modifying the registers.

Mode	Service Adjustment	Adjustment Range	Def Val.	Original Value	New Value
Sub Adjustments					
B0	Sub Color	0 ~ 63	33		
B1	Sub Tint	0 ~ 63	33		
B2	Sub Brightness	0 ~ 255	80		
B3	Sub Contrast	0 ~ 63	34		
B4	Killer/ABL/Gamma	0 ~ 7	5		
B5	Video Adjustment	0 ~ 15	8		
B6	Audio Adjustment	0 ~ 31	16		
B7	V-Size	0 ~ 63	20		
White Balance Adjustments					
C0	RED Cutoff	*	0 128		
C1	GRN Cutoff	0 ~ 255	64		
C2	BLU Cutoff	*	0 128		
C3	R Drive	0 ~ 127	64		
C4	Blue Drive	0 ~ 127	64		
C5	YNR Switch	0 ~ 1	0		
C6	AFT	*	0 120		
C7	RF AGC	0 ~ 127	64		
C8	YNR	0 ~ 7	0		
C9	Horizontal-Center	0 ~ 31	16		
Ca	Beam Limit	0 ~ 7	0		
Cb	Y Delay	0 ~ 2	2		

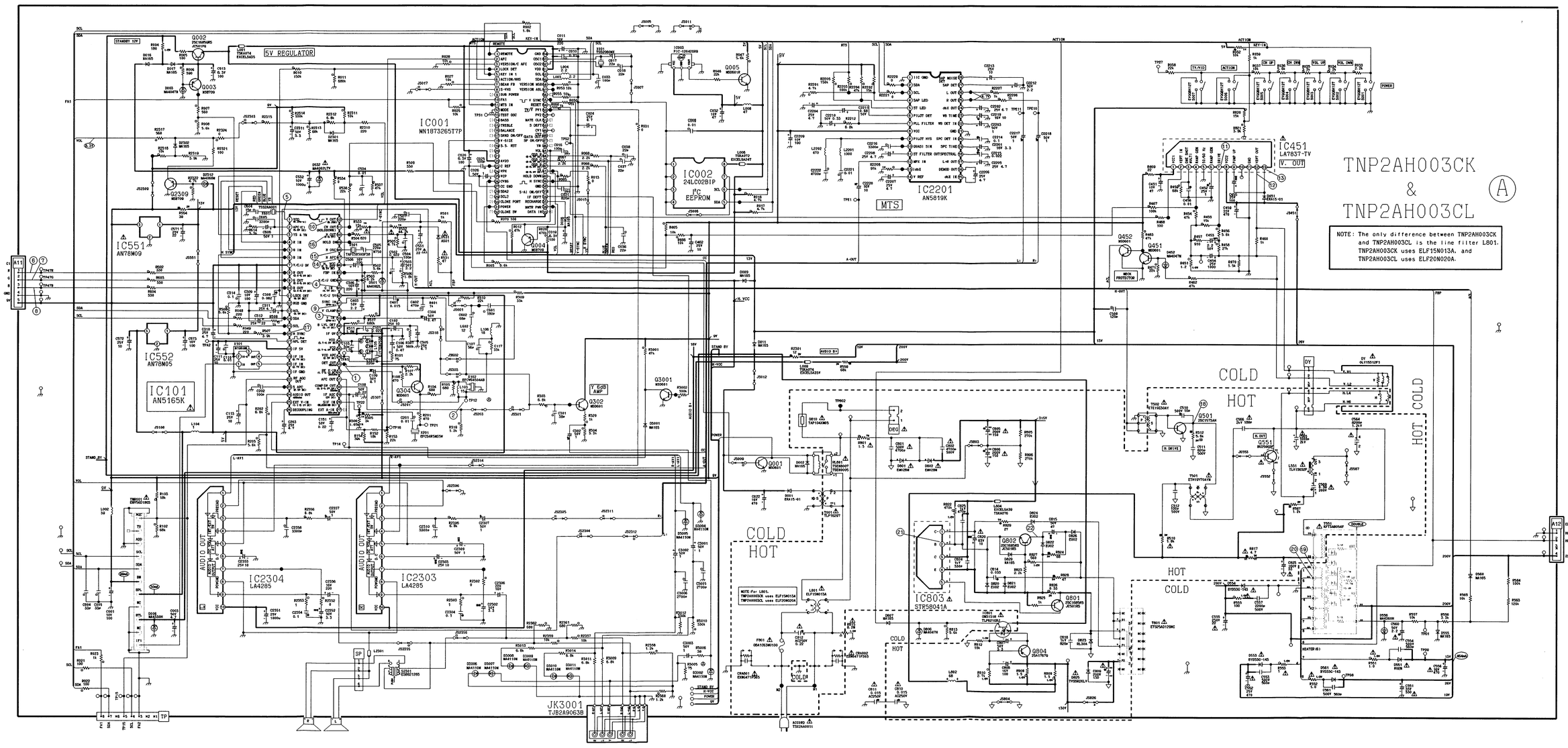
* Adjustment indicated in steps:
0 0 ~ 0 255
1 0 ~ 1 255

Mode	Service Adjustment	Adjustment Range	Def. Val.	Original Value	New Value
Options Adjustments					
S0	PIP Color	0 ~ 63	25	N/A	N/A
S1	PIP Contrast	0 ~ 127	52	N/A	N/A
S2	Up 1/9	0 ~ 255	26	N/A	N/A
S3	Down 1/9	0 ~ 255	146	N/A	N/A
S4	Left 1/9	0 ~ 255	9	N/A	N/A
S5	Right 1/9	0 ~ 255	103	N/A	N/A
S6	Up 1/16	0 ~ 255	27	N/A	N/A
S7	Down 1/16	0 ~ 255	163	N/A	N/A
S8	Left 1/16	0 ~ 255	9	N/A	N/A
S9	Right 1/16	0 ~ 255	118	N/A	N/A
Sa	Freerun	**	**	N/A	N/A
Sb	Clock Adjustment	0 ~ 255	128		
Sc	Pip Tint	0 ~ 63	50	N/A	N/A
Sd	Loudness Compensation	0 ~ 63	52		
MTS Adjustments					
M0	Input Level	0 ~ 63	31		
M1	Stereo PLLVCO	0 ~ 63	31		
M2	Filter	0 ~ 63	31		
M3	Low-level Separation	0 ~ 63	31		
M4	High-level Separation	0 ~ 63	31		

** Factory Only.

Printed in USA

A-Board Schematic
20CX20B511 & 20CX20501



IMPORTANT SAFETY NOTICE

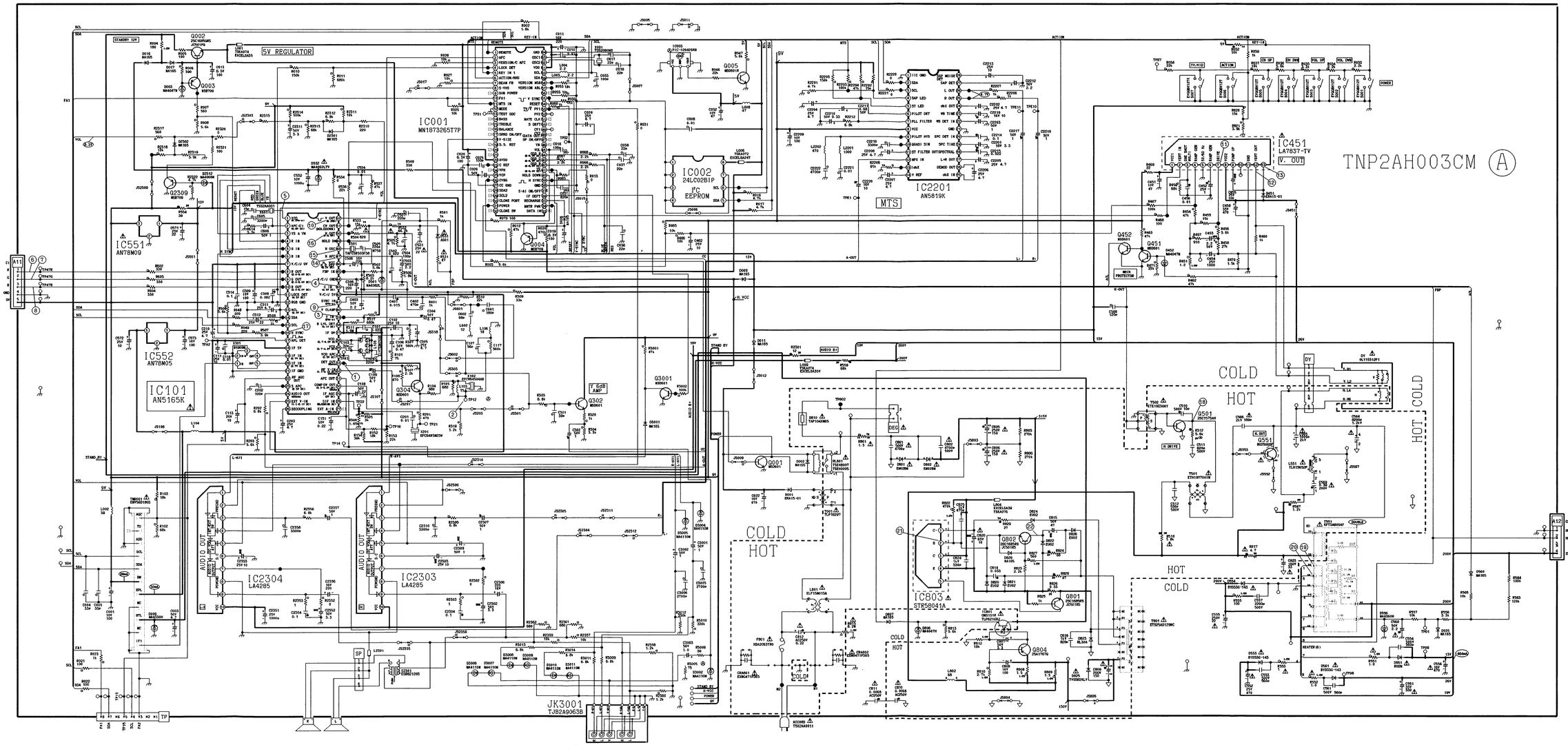
THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES THAT ARE IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURERS SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS DESIGNATED WITH A ⚠ IN THE SCHEMATIC.

Board Index
"A"-Board – Main Chassis
"C"-Board – CRT Board

A | B | C | D | E | F | G | H

1 | 2 | 3 | 4 | 5

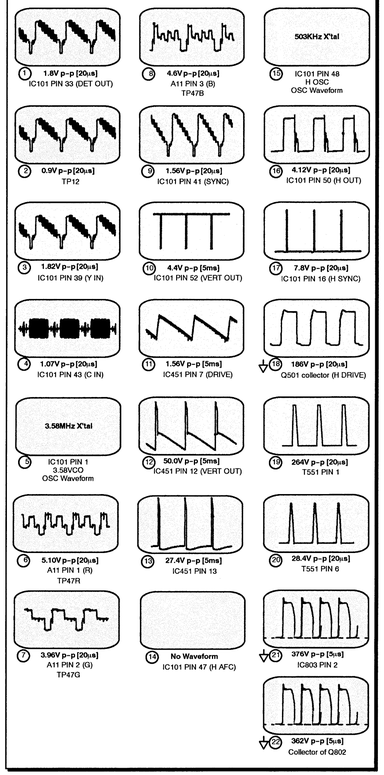
A-Board Schematic
20CX20B521



Sheet 1 of 2
Side B

A-Board Schematic
20CX20B521
20CX20B511, 20CX20B501, & 20CX20B521

Waveforms – A–Board


1 1.8V p-p [20µs] IC101 PIN 33 (DET OUT)
8 4.6V p-p [20µs] A11 PIN 3 (B) TP47B
503Khz X'tal
15 IC101 PIN 48 H OSC OSC Waveform
2 0.9V p-p [20µs] TP12
9 1.56V p-p [20µs] IC101 PIN 41 (SYNC)
16 4.12V p-p [20µs] IC101 PIN 50 (H OUT)
3 1.82V p-p [20µs] IC101 PIN 39 (Y IN)
10 4.4V p-p [5ms] IC101 PIN 52 (VERT OUT)
17 7.8V p-p [20µs] IC101 PIN 16 (H SYNC)
4 1.07V p-p [20µs] IC101 PIN 43 (C IN)
11 1.56V p-p [5ms] IC451 PIN 7 (DRIVE)
18 186V p-p [20µs] Q501 collector (H DRIVE)
3.58MHz X'tal
5 IC101 PIN 1 3.58VCO OSC Waveform
12 50.0V p-p [5ms] IC451 PIN 12 (VERT OUT)
19 264V p-p [20µs] T551 PIN 1
6 5.10V p-p [20µs] A11 PIN 1 (R) TP47R
13 27.4V p-p [5ms] IC451 PIN 13
20 28.4V p-p [20µs] T551 PIN 6
7 3.96V p-p [20µs] A11 PIN 2 (G) TP47G
14 No Waveform IC101 PIN 47 (H AFC)
21 375V p-p [5µs] IC803 PIN 2
22 362V p-p [5µs] Collector of Q802

Waveform Measurements

1. (3) indicates waveform measurement. (Measurement can be taken at the best accessible location in common to the indicated point.)
2. Taken with a NTSC signal generator connected to the antenna terminal. (NTSC color bar pattern of 8 bars of EIA colors, 100 IRE white and 7.5 IRE black.)
3. Customer Controls (Picture/Audio Menu) are set to Normalize. Volume is set to "MIN".
4. All video and color waveforms are taken with a wideband scope and a probe with low capacitance (10 to 1). Shape and peak amplitudes may vary depending on the type of Oscilloscope used and its settings.
5. Ground symbol ⏚ shown on waveform number indicates (Hot) ground lead connection of the Oscilloscope. **CAUTION:** Incorrect ground connection of the test equipment will result in erroneous readings.

The waveforms are taken in the order of circuit flow through the various sections as follows:

VIDEO – Waveforms 1–3
COLOR – Waveforms 4–8
VERTICAL – Waveforms 9–13
HORIZONTAL – Waveforms 14–17
CRT DRIVE – Waveforms 18–20
POWER SUPPLY – Waveforms 21–22

Schematic Notes

1. Resistors are carbon 1/4W unless noted otherwise.
2. Capacitors are ceramic 50V unless noted otherwise.
3. Coil value noted is inductance in µH.
4. Test point indicated by ◆; Test point but no pin ○
5. Components indicated with ⚠ are critical parts and replacement should be made with manufacture specified replacement parts only.
6. ▬ **(BOLD LINE)** Indicates the route of B+ supply.
7. The schematic diagrams are current at the time of printing and are subject to change without notice.
8. Ground symbol ⏚ indicates **HOT GROUND CONNECTION;** ⫽⫽ indicates COLD GROUND.

NOTE: All other component symbols are used for engineering design purposes.

Voltage Measurements

1. Voltage measurement:
   - AC input to the Receiver is 120V. NTSC generator is connected to the antenna of the Receiver. (Color bar pattern of 100IRE white and 7.5 IRE black.)
   - All Picture and Audio adjustments are set to Normalize.
     TV ANT/CABLE – (Set-Up Menu) in TV/ANT Mode
     Volume – Min
     TV/Video SW – TV position
     Audio Mode – Stereo
   - Voltage readings are nominal and may vary ±10% on active devices. Some voltage reading will vary with signal strength and picture content.
   - Supply voltages are all nominal.
2. Ground symbol ⏚ indicates ground lead connection of meter. **Caution: Incorrect ground connection will result in erroneous readings.**

Voltage Measurements "A" & "C"–Boards

IC001

01	0.04	33	0.00
02	2.59	34	5.00
03	0.00	35	5.08
04	3.45	36	0.00
05	5.10	37	0.00
06	2.66	38	0.00
07	0.00	39	0.16
08	0.00	40	4.12
09	0.00	41	0.00
10	5.11	42	0.00
11	0.27	43	0.00
12	0.00	44	0.00
13	2.56	45	1.37
14	0.00	46	1.67
15	0.00	47	0.00
16	0.00	48	0.00
17	0.00	49	0.00
18	4.06	50	0.00
19	0.00	51	3.25
20	0.00	52	0.00
21	0.00	53	0.00
22	5.11	54	** 5.12
23	–0.06	55	4.38
24	1.33	56	5.15
25	1.17	57	2.06
26	1.63	58	0.02
27	0.00	59	0.07
28	0.00	60	3.93
29	0.00	61	5.16
30	0.00	62	0.00
31	5.04	63	5.15
32	0.00	64	0.00

IC101

01	3.08	27	4.33
02	5.62	28	3.16
03	0.00	29	2.62
04	0.00	30	2.86
05	0.00	31	4.76
06	0.00	32	2.00
07	8.90	33	2.88
08	3.37	34	2.56
09	3.31	35	3.41
10	3.43	36	3.41
11	4.26	37	8.90
12	0.00	38	3.96
13	3.44	39	4.13
14	4.36	40	2.89
15	4.37	41	4.17
16	0.29	42	4.96
17	3.56	43	3.58
18	4.96	44	0.00
19	2.75	45	0.46
20	2.75	46	6.14
21	0.00	47	4.15
22	2.64	48	2.32
23	5.27	49	5.15
24	4.27	50	0.92
25	1.70	51	6.25
26	5.85	52	4.15

IC551

01	12.61
02	0.00
03	8.91

IC552

01	12.61
02	0.00
03	4.99

** **WARNING**
CRT may shut off when probing this pin. Shut Receiver off and turn back on to continue testing

IC002

01	0.00
02	0.00
03	0.00
04	0.00
05	4.45
06	4.37
07	0.00
08	5.11

IC003

01	5.16
02	0.00
03	2.89

IC801 ⏚

01	0.69
02	0.00
03	0.00
04	11.93

IC803 ⏚

01	87.90
02	130.70
03	321.80
04	130.50
05	131.50

IC451

01	8.80
02	4.15
03	4.40
04	4.48
05	0.00
06	4.33
07	4.20
08	23.96
09	2.35
10	1.50
11	0.00
12	13.30
13	24.60

IC2201

01	0.00	15	3.90
02	4.43	16	4.46
03	4.43	17	4.44
04	0.34	18	4.47
05	0.08	19	0.72
06	6.12	20	4.47
07	2.69	21	0.00
08	8.90	22	4.53
09	4.52	23	0.73
10	4.48	24	4.26
11	4.49	25	4.73
12	4.36	26	4.39
13	3.07	27	5.40
14	4.48	28	5.10

IC2303

01	6.24
02	0.00
03	6.26
04	0.76
05	0.78
06	8.93
07	9.00
08	0.00
09	9.10
10	19.13

IC2304

01	6.26
02	0.00
03	6.28
04	0.76
05	0.78
06	8.50
07	8.53
08	0.00
09	9.10
10	19.10

CHIP TRANSISTOR LEAD DESIGNATION

	Q001	Q002	Q003	Q004	Q005	Q302	Q304	Q451
B	0.73	5.83	4.95	5.09	0.65	2.87	2.88	0.64
C	0.07	9.21	5.80	0.00	0.04	8.90	8.90	0.02
E	0.00	5.11	5.80	5.07	0.00	2.27	2.26	0.00

	Q452	Q501 ⏚	Q551 ⏚	Q801 ⏚	Q802 ⏚	Q804 ⏚	Q2309	Q3001
B	0.02	0.00	–0.06	129.00	129.70	129.80	5.83	0.00
C	3.44	99.80	134.00	131.50	130.10	0.59	0.00	8.85
E	0.00	0.00	0.00	130.40	130.60	130.20	2.61	0.00

	Q351	Q352	Q353
B	3.36	3.29	3.41
C	130.00	133.00	127.20
E	3.14	3.03	3.15

Note: Stereo Models

The Functions listed below are activated by a DC voltage change to DAC Inputs(Pin 5 and 6) of MPU IC001. Press and hold a function button on the Receiver to measure voltages.

FUNCTION	PIN 5	PIN 6
POWER	0V~0.443V	N/A
VOL ◀	0.797V~1.07V	N/A
VOL ▶	1.424V~1.696V	N/A
CH ▼	2.05V~2.323V	N/A
CH ▲	2.677V~2.95V	N/A
TV/VIDEO	3.304V~3.576V	N/A
ACTION	N/A	0V~0.443V
SHUT DOWN	N/A	3.930V~5.000V

The AUDIO MODES being broadcast are displayed on screen in red by the voltage change to DAC input (Pin 11) of MPU IC001.

AUDIO MODE BROADCAST	PIN 11 MN1873265T7G
MONO	4.0V~5.0V
SAP	2.2V~3.8V
STEREO	0.9V~1.9V
STEREO & SAP	0V~0.6V

Tuner Voltage Chart

Enable, Data, and Clock have no DC readings. They are digital signals from the MPU.

NOTE: Voltage at the 30V test pin varies with channel selection. Refer to chart for sample tuning voltages of TV/CATV(CABLE) channels as shown.

Voltage Reading Are Nominal And May Vary ± 15%

– VHF –	
Ch. 02	4.0V
Ch. 06	8.2V
Ch. 07	7.0V
Ch. 13	9.3V

– UHF –	
Ch. 14	7.7V
Ch. 69	24V

– CABLE –					
1st Band		2nd Band		3rd Band	
Ch. 1	6.7V	Ch. 16	4.5V	Ch. 47	3.7V
Ch. 15	24.7V	Ch. 46	2.70V	Ch. 94	14.9V
Ch. 95	9.8V			Ch. 100	15.1V
Ch. 99	17.5V			Ch. 125	24.0V

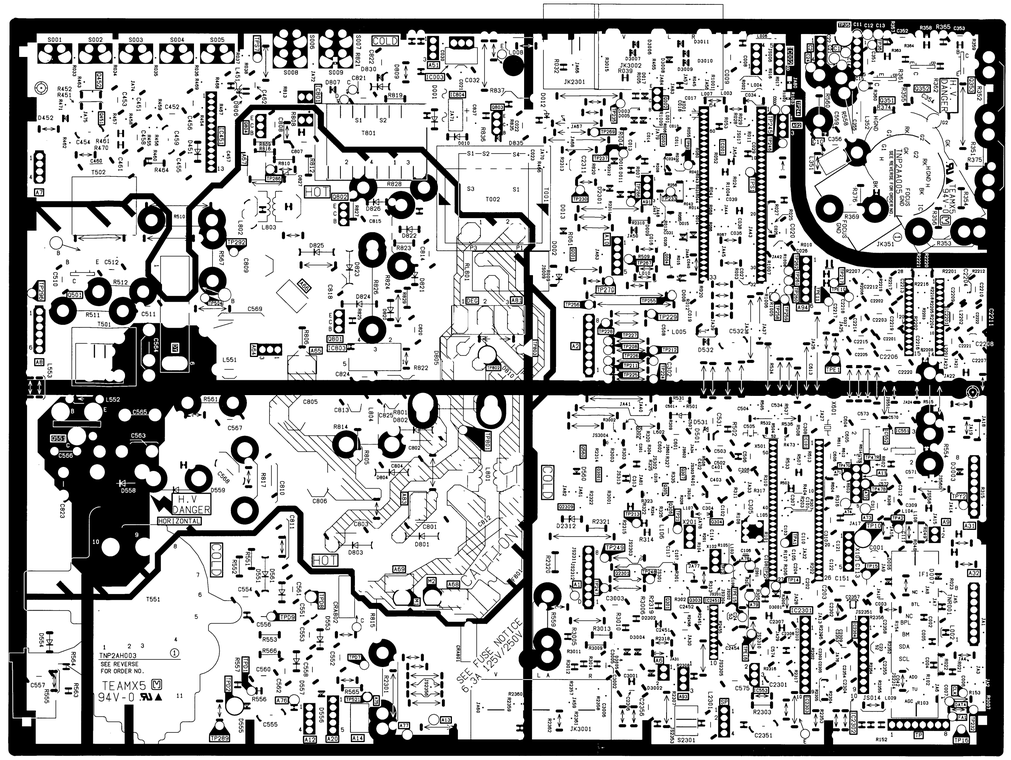
MICROPROCESSOR PROGRAMMING FOR BAND TUNING/SWITCHING

54MHz ◀▶ 130MHz ◀▶ 360MHz ◀▶ 806MHz

	FIRST TUNING BAND	SECOND TUNING BAND	THIRD TUNING BAND
VHF	02~06	07~13	
UHF			14~69
CABLE	01~06,14,1 5, 95~99	07~13, 16~46	47~94, 100~125

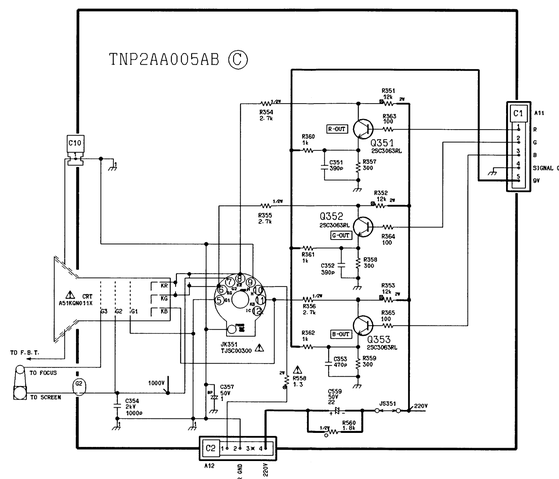
NOTE: CABLE channel numbers as recommended by the joint EIA/NCTA Engineering Committee and published as EIA INTERIM STANDARD NO. 6 – CABLE TELEVISION CHANNEL IDENTIFICATION PLAN – MAY 1983.

A–Board Layout



C–Board Layout

C–Board Schematic
ALL MODELS



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